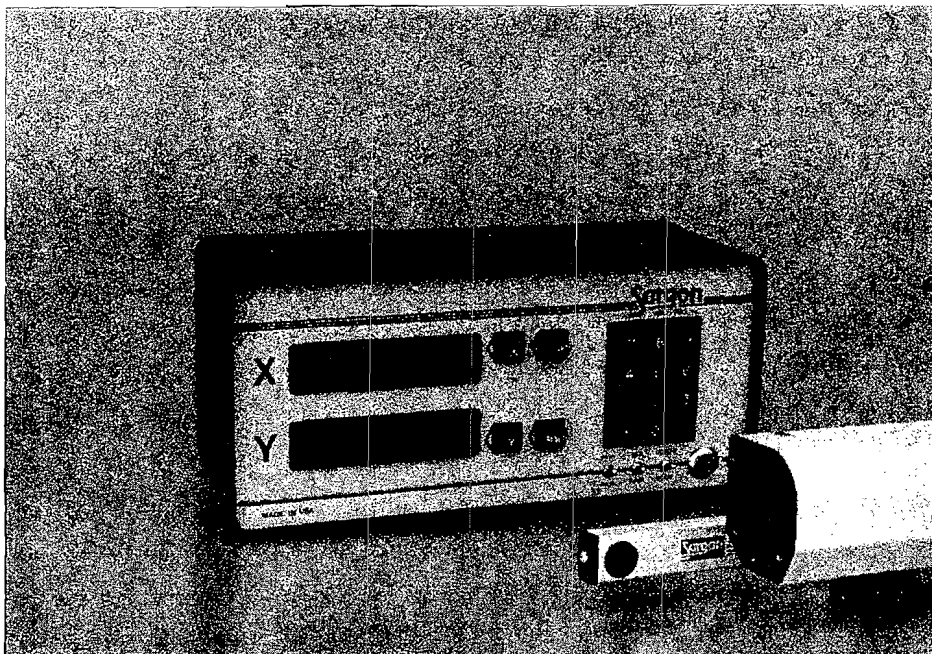


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The Leader of D.R.O. Technology



INSTALLATION, SERVICE AND MAINTENANCE MANUAL

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APPLICATION NOTE 8502

XT-200 MINI LINEAR SCALE

TYPICAL LATHE RETRO-FIT

SMALLEST IN SIZE, BUT BIGGER IN PERFORMANCE.

The Series XT-200 Linear Scale is the smallest DRO scale on the market today. Being only 0.6" deep and 0.97" high, the XT Series is approximately 25% smaller than other similar glass scales. For the first time ever, it is not necessary to pay thousands of dollars for a DRO system that will fit in those minute areas.

Space-age technology and micro-electronics have shrunk the scale, reader head, and increased accuracy, reliability, performance and cost effectiveness. Metrilon wear pads are permanently masked on the optical encoders to automatically set an accurate 1 mil air gap between the moving and stationary components of the encoder.

Metrilon is a new technology which has proven to be cost effective, improve performance, and reduce size of optical encoders.

RELIABILITY WITH PERFORMANCE

New technology not only allowed the XT Series to be the smallest glass scale on the market, but it also promoted improvements

in reliability, performance and reduced cost. These improvements were realized by uniting miniaturized ball-bearing rollers, metrilon reticle pads, new solid state electronics and innovative packaging.

Incorporating metrilon encoder reticle pads has significantly reduced the air gap degradation that has plagued other similar type scales. Conclusion of extensive tests have depicted little or no pad wear after a million inches of travel.

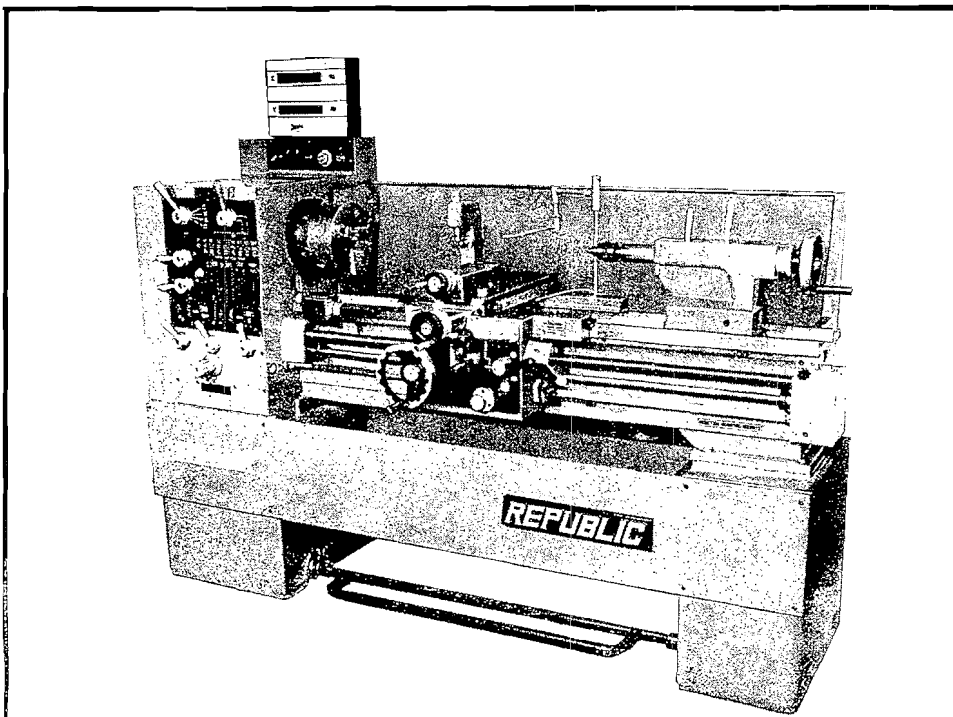
Using ball-bearing guides has notably reduced wear as the encoder slides up and down the glass scale, improved repeatability, and accuracy, and also reduced hysteresis error.

Using the latest solid state electronics, including long-life infrared light sources, has allowed only the optics to be incorporated in the encoder. Sub-miniature signal conditioning, analog to digital conversion and amplification electronics have been combined into the external interfacing cable connector. This feature has reduced encoder weight by more than 50%, therefore further reducing encoder wear and hysteresis error.

Additional features of these exclusive engineering achievements are: miniaturized plug-in bipolar integrated electronics packaged externally from the scale/encoder makes repairs simple, reduces packaging and environmental cost, and furthermore increases slew rates up to 45 inches per second.

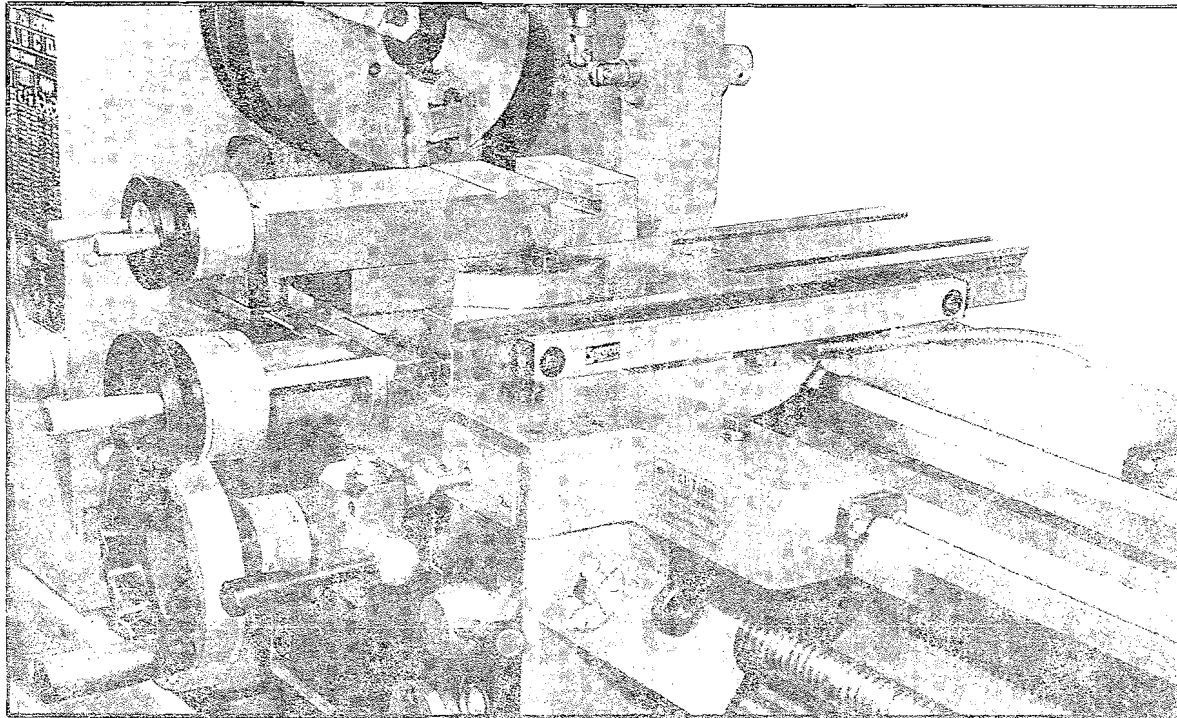
ACCURACY

The XT-200 Series accuracies are assured by using vacuum deposited chrome on soda lime glass scales. Each chrome line width is held at an incredible tolerance of better than 45-55% of a cycle. Accuracies of better than 50 micro inches have been assured by generating replication masters with advanced numerically controlled laser interferometer techniques that are traceable to National Bureau of Standards. Environmental conditions have been stringently controlled with seismic isolation facilities, temperature uniformity of better than 0.01° Fahrenheit, humidity controls and automatic barometric compensation to within 1 part in 10 million.



- ★ **ENHANCED INSIDE-DIAMETER MEASUREMENT**
- ★ **30 to 50% INCREASE IN PRODUCTION**
- ★ **REDUCTION IN SCRAP**
- ★ **INCREASED PROFITS**
- ★ **EASY TO OPERATE**
- ★ **TWO YEAR WARRANTY**
- ★ **NBS TRACEABILITY**
- ★ **100% ON-SITE SERVICEABILITY**
- ★ **20% POWER REGULATION**

**TYPICAL 8 to 12" CROSS TRAVEL by 36" to 40"
LONGITUDE TRAVEL SYSTEM INCLUDING HARDWARE
Can be yours for as little as
\$1195.00**



| | XT-230 | XT-250 |
|-----------------------|---|------------------|
| RESOLUTION | 0.00025" (0.005mm) | 0.0005" (0.01mm) |
| ACCURACY PER FOOT | 250 μ inches | 250 μ inches |
| REPEATABILITY | 300 μ inches | 300 μ inches |
| RECOMMENDED DISPLAY | 700 Series | 700 Series |
| SLEW-RATE | 50"/Sec. | 50"/Sec. |
| LIGHT SOURCE | FOUR INFRARED LIGHT-EMITTING DIODES (FIVE FOR ABSOLUTE OPTIONS) | |
| SENSING ELEMENT | FOUR PHOTOTRANSISTORS (FIVE FOR ABSOLUTE OPTIONS) | |
| ENCODER OUTPUT SIGNAL | QUADRATURE SQUARE WAVES TTL OR CMOS COMPATABILITY IS AVAILABLE | |
| AMBIENT TEMPERATURE | 0° TO 50° | |
| SCALE LENGTHS | 2" (50mm) TO 50" (1315mm) | |
| POWER REQUIREMENTS | OPTIONAL + 10V \pm 20% or 5V \pm at APPROXIMATELY 175ma | |

Sargon Industries reserves the right to change specifications, designs, prices, and models without notice.

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INDUSTRIES, INC.

APPLICATION NOTE 8504

XT-200

MINI LINEAR SCALE

UNIVERSAL HEIGHT GAGE RETRO-FIT

SMALLEST IN SIZE, BUT BIGGER IN PERFORMANCE.

The Series XT-200 Linear Scale is the smallest DRO scale on the market today. Being only 0.6" deep and 0.97" high, the XT Series is approximately 25% smaller than other similar glass scales. For the first time ever, it is not necessary to pay thousands of dollars for a DRO system that will fit in those minute areas.

Space-age technology and micro-electronics have shrunk the scale, reader head, and increased accuracy, reliability, performance and cost effectiveness. Metrilon wear pads are permanently masked on the optical encoders to automatically set an accurate 1 mil air gap between the moving and stationary components of the encoder.

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Incorporating metrilon encoder reticle pads has significantly reduced the air gap degradation that has plagued other similar type scales. Conclusion of extensive tests have depicted little or no pad wear after a million inches of travel.

Using ball-bearing guides has notably reduced wear as the encoder slides up and down the glass scale, improved repeatability, and accuracy, and also reduced hysteresis error.

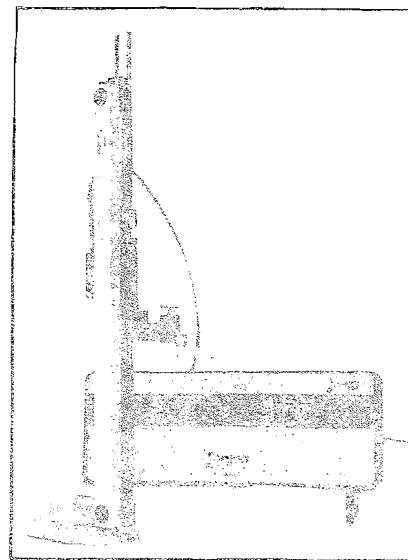
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encoder makes repairs simple, reduces packaging and environmental cost, and furthermore increases slew rates up to 45 inches per second.

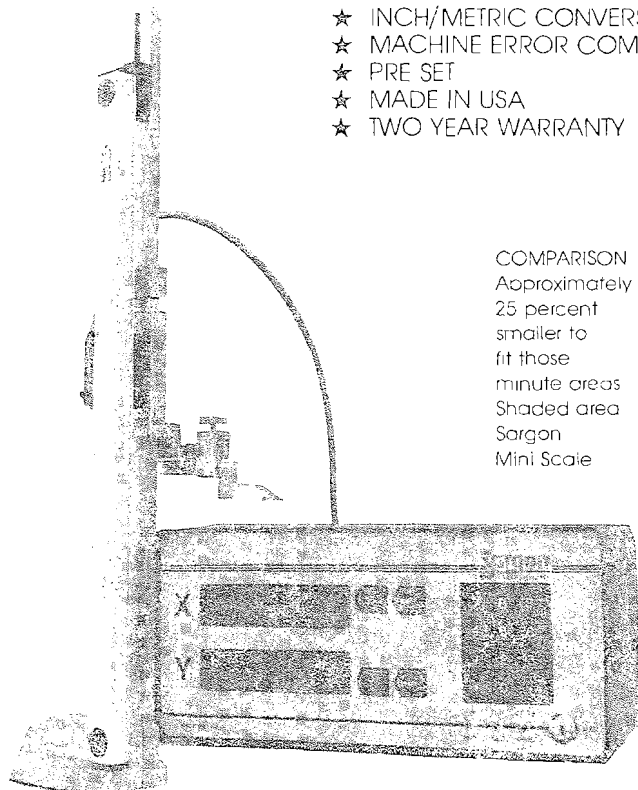
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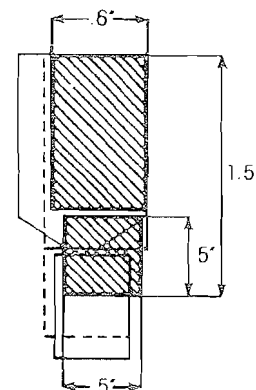


AVAILABLE FEATURES

- ★ LOW PRICE
- ★ ABSOLUTE/INCREMENTAL OPERATION
- ★ NON-VOLATILE MEMORY
- ★ INCH/METRIC CONVERSION
- ★ MACHINE ERROR COMPENSATION
- ★ PRE SET
- ★ MADE IN USA
- ★ TWO YEAR WARRANTY



COMPARISON
Approximately
25 percent
smaller to
fit those
minute areas
Shaded area
Sargon
Mini Scale



TERMS AND CONDITIONS OF SALE

The following terms and conditions shall be a part of any contract of sale which may be entered into between the Buyer and Seller. Any terms and conditions in Buyer's purchase order acknowledgement or any other writing pertaining to such order, irrespective of its wording or of when received by us, which are in conflict or inconsistent with or add to the terms and conditions hereof, will not be acceptable or become a part of any resulting contract without our express typed or handwritten consent. Neither acknowledgement and return of a copy of Buyer's purchase order or other form, irrespective of its terms, nor the filling and shipment of such order, shall constitute acceptance of such conflicting, inconsistent or additional terms nor shall they in any way operate to modify or change the full effect of the terms and conditions herein.

1. PRICE AND TERMS OF PAYMENT

- a. Prices of products are published separately. The acceptance of orders is subject to the approval of our Credit Department. Unless otherwise specifically agreed upon in writing, our terms are net 30 days from date of invoice. All payments are to be made in USA funds.
- b. Prices are subject to change without notice at any time prior to shipment.
- c. Export orders, unless otherwise specifically agreed upon in writing shall be payable in USA funds.
- d. Taxes Unless otherwise indicated no Sales, Use, Retailers, Occupation, Service Occupation, Service Use or other similar taxes are included in our prices. The amount of any such taxes which are paid or payable, or assessed, in connection with any order, and which shall be paid by the customer to us or, if authorized by law, by the customer directly to the taxing authority.
2. **CONFIRMING ORDERS:** Seller shall hold Buyer responsible for any order that is duplicated by Seller because Buyer failed to mark the order "CONFIRMING ONLY" boldly on the face of the order. Buyer must indicate, on the face of the written quotation from Seller, or the date and person at SARGON INDUSTRIES, INC., to whom the order is confirmed.
3. **DELIVERY:** All shipments and prices are quoted FOB origin. Title to all goods shall pass to Buyer upon delivery to a common carrier or when Buyer takes possession of goods at Seller's place of business. Seller shall not be liable for delay in delivery or for failure to perform due to causes beyond the reasonable control of Seller. These causes shall include, without limitation, acts of God, act or omissions of Buyer, civil or military authorities, delays in transportation, or inability to obtain necessary labor, materials or supplies. In the event of any delay, the contractual date of delivery, if any shall be extended for a period equal to the time lost as a consequence of such delay, without penalty to Seller or any liability on Seller's part. Seller shall have the right to deliver all goods covered hereby at one time or in portions from time to time, within the time for delivery provided in such order.
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5. **CREDIT:** In case Buyer shall fail to make payments on this or any other contract between Buyer and Seller in accordance with Seller's terms, Seller may defer future shipments until such payments are made, or may, at its option, cancel unshipped balance. Seller reserves the right to refuse all orders deemed unacceptable by reason of terms of payment, financial responsibility, or other sound business reasons. In addition to the prices stated herein, the Buyer expressly agrees to be liable for interest at the maximum allowable contract rate under applicable law on past due accounts and for collection cost, including attorney's fees, court and other costs involved in the collection of past due accounts. The Buyer expressly agrees to be liable for any LATE CHARGE as may be permitted by California law. The LATE CHARGE will be computed and applied at the rate of 5% of each past due payment or at \$5.00 minimum charge for each 30 DAY PERIOD PAST DUE whichever is greater. Seller retains and Buyer hereby grants a security interest on the goods, including all accessions to and replacements of them until Buyer has made payment in full. Buyer shall cooperate fully with Seller in executing such documents, including a Uniform Commercial Code financing statement, and accomplishing such filings and/or recordings thereof as Seller may deem necessary for the protecting of such security interests.

Payment must be made from this invoice. No statements issued or customer supplied voucher forms completed.
\$20.00 re-billing charge on unearned discounts and/or deductions.

6. SHIPMENT

- a. The time of delivery named by us is the date for shipping from our plant or warehouse. We will not be liable for delays in delivery caused by any reason beyond our control including but not limited to acts of God, casualty, civil disturbance, labor disputes, transportation or supply difficulties, any interruption of facilities, or act of governmental authority and the time for delivery specified herein shall be extended during the continuance of such conditions and for a reasonable time thereafter.
- b. Examine material closely before making claim for shortage as this material was checked before shipping. All claims for defective merchandise must be made within 5 days after receipt of goods. Make claims for breakage or damage in transit to carrier as we hold shipping receipt in good order. Claims for shortage or incorrect material must be made within 5 days of receipt of goods and accompanied by original packing sheet. Material returned for credit subject to a handling charge.
- c. Unless otherwise agreed upon in writing, all shipments are f.o.b. our plants or warehouses from which material is shipped. We are not responsible for damage to or loss of products after delivery to the transportation company. If the customer should have a claim against the transportation company, however, we will cooperate in attempting to secure an adjustment when so requested.
- d. We will decide how to pack and to ship unless specific instructions are given.
- e. Where shipment from stock is indicated material is subject to prior sale.
- f. All orders will be shipped UPS if possible and at the convenience of Sargon Ind. the Buyer may request an alternate shipping method and/or carrier; in so doing however Sargon Ind. acts on the customer's behalf without responsibility on itself.
7. **TRANSFER OF OWNERSHIP:** "The seller shall retain ownership of the products supplied until payment in full has been received by him. As the seller retains ownership until the products are paid for, they may not be sold and Sargon Ind. reserves product ownership even when transferred by original customer to another party securing his claim against the customer until full payment is received."
8. **PROPRIETARY INFORMATION:** "Sargon Ind. is the owner and retains full title and copyright privileges on any supplied design/application information which may be patentable, etc. even when provided to a third party. Any and all papers regarding same are to be returned upon request."
9. **TRANSPORTATION CHARGES**
 - a. Premium rate services such as Express (Rail or Air) Air-freight, etc. will be utilized only when specified by customer. If prepayment is requested our invoice will show an addition equal to the excess transportation charges.
 - b. Unless otherwise requested in writing, goods shipped by Parcel Post will be insured and the postal fee and insurance charges will be added to the invoice.
10. **SELLER'S RIGHT TO INCREASE PRICES:** Seller reserves the right to increase the selling price of any and all goods ordered by Buyer but not shipped from Seller's place of business, prior to an increase in Seller's cost of such goods as reflected by a price increase to Seller from Seller's supplier. The selling price quoted herein shall, upon increase in price by Seller's supplier, be increased by a percentage equal to the percentage of increase in Seller's cost for the goods, and Buyer agrees to pay any such increased price in accordance with the terms hereof.

Seller reserves the right to change price, specifications, and manufacturer without notice.

11. **PATENTS:** Seller shall have no liability of any kind with respect to any actual or alleged infringement of any United States or foreign patent, trademark or similar right.
12. **INSTALLATION:** Buyer shall be solely responsible for the installation and operation of the goods covered herein, including without limitation, the obtaining of all permits, licenses or certificates required for the installation or use of such goods. All Sargon Industries Inc. linear encoder accuracies are directly traceable to the United States National Bureau of Standards Via Primary and Secondary Standards. Machine tool system positioning accuracies are directly related, but not limited to, the condition of the machines slides, way, gibs, bearings, table deflection, lead screw, and work piece distance from the linear encoder. Thereof any cost that Sargon inherits that is traceable to machine tool error, buyer's installation or non-compliance to standard machine tool practices, shall be paid for by the Buyer.
13. **MINIMUM ORDER CHARGE:** The minimum charge on any customer order will not be less than \$100.00
14. A standard charge of \$4.00 per invoice or \$2.00 per box, whichever is the greatest will be added to each invoice to cover the cost of packaging material. Cost of Special boxing, export boxing, cartage to steamer or transit or expenses will be added to invoices.
15. **DESIGNS, DIMENSIONS AND WEIGHTS:** Because we are constantly improving our products, the designs, dimensions, and weights shown in our catalogs, while sufficiently accurate for most purposes, are subject to variation. If extreme accuracy is required, additional information and certification will be provided upon request after receipt of order.
16. **DISPUTES:** All disputes under any contract concerning the goods not otherwise resolved between Seller and Buyer shall be resolved in a court of competent jurisdiction for the location of the Seller's place of business and in no other place, provided, however that in Seller's sole discretion, such action may be heard in some other place designated by Seller (if necessary to acquire jurisdiction over third persons), so that the dispute can be resolved in one action. Buyer agrees to appear in any such action and hereby consents to the jurisdiction of such court. No action, regardless of form, arising out of, or in any way connected with the goods furnished or services rendered by Seller, may be brought by Buyer more than one (1) year after the date of sale.
17. **GOVERNING LAW:** This agreement and performance by the hereunder shall be governed by the uniform Commercial Code of the State of California.
18. **RETURN OF EQUIPMENT:** No material will be accepted for return for credit after 90 days. All returns must have a return authorization number and include the original invoice or packing slip number. Return due to customer's error must be returned prepaid and will be subject to a \$50.00 administration fee plus a 10% restocking charge.
19. **QUOTATIONS:** All Quotations will have a validity of 30 days.
20. **WARRANTY:**
 - a. Sargon's Digital Readout products and specifications are warranted against defective materials and workmanship for two years from date of purchase.
 - b. This warranty covers all parts except for consumable items. This warranty applies only to DRO Systems and accessories that have been installed and operated in accordance with Sargon's guidelines, instructions and recognized reference publications. This warranty is void when the systems are misused, damaged or exposed to hostile environment, such as but not limited to electrical or electromagnetic noise.
 - c. **Two Year Parts Warranty:** Within two years from date of purchase, all warranted parts will be replaced or repaired without charge except for labor, freight and forwarding fees to and from point of repair. Sargon Ind. is not liable for any design engineered and/or furnished by the Buyer and incorporated into equipment.
 - d. **One Year Warranty:** If within one year from the date of purchase any such defect is found, the part, or parts, will be replaced or repaired without charge except for inherited freight and forwarding fees from point of repair.
 - e. **Disclaimer of Implied warranties:** The foregoing warranties of Sargon Industries are in lieu of all other warranties, expressed or implied. Sargon Industries specifically disclaims any implied warranties or merchantability or fitness for a particular purpose. In no event will Sargon Industries be liable for special or consequential damage, including any product which has been operated in excess of its electrical, mechanical, or environmental rating, or which has been subject to abuse, or in which the housing has been altered or tampered with.
21. **CHANGES:** If a quotation provides for products to be custom made for special applications, the quoted price is applicable only where correct tolerance requirements are provided by the customer by print or sample part. We have the right to terminate such orders without obligation to either party if, in our opinion, it is not possible to meet the required specifications. If changes in fabrication or design are required by reason of incorrect tolerances furnished or deviation from prints or samples submitted the cost of such changes shall be at the customer's expense and shall be added to the quoted price.
22. **CANCELLATION:** Suspension or cancellation of orders may be made upon our written approval and on terms that will indemnify us against all loss.
23. **ORDER ACCEPTANCE:** Orders shall not be deemed accepted until approved in writing at our plant. Seller reserves the right to refuse any order.
24. **GENERAL:**
 - a. These terms and conditions are subject to change without notice.
 - b. Unless otherwise stated, a quotation is valid only for a period of 30 days from date of the quotation.

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I. 100 SERIES SCALE ASSEMBLY INSTALLATION PROCEDURES

A. INTRODUCTION:

The following instructions are guidelines for installation of SARGON'S 100 Series spar, glass scale and encoder assembly.

NOTE

This manual describes installation procedures for Bridgeport type knee mills. All part numbers are located on individual hardware kit drawings located in each hardware kit. To order replacement or additional parts, use the kit part number and machine manufacturer reference, as some dimensions and parts may vary between manufacturers.

NOTE

Other machine types may require special hardware fabrication. The actual scale installation in all cases, follows the same concepts, custom installations may be completed without assistance; however, factory assistance is available if necessary.

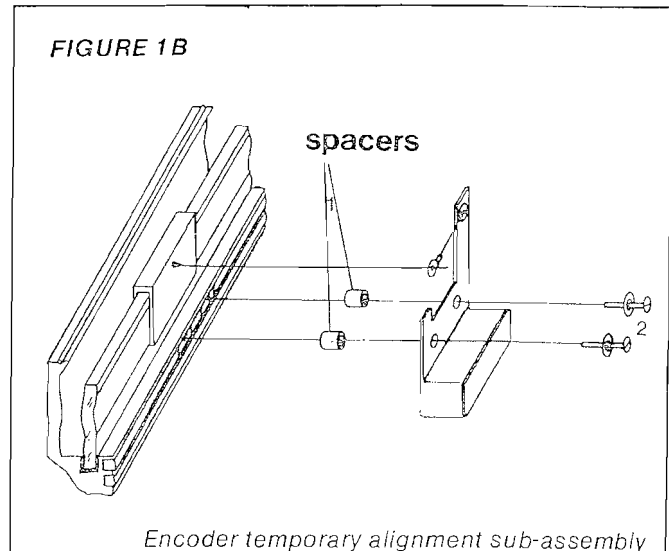
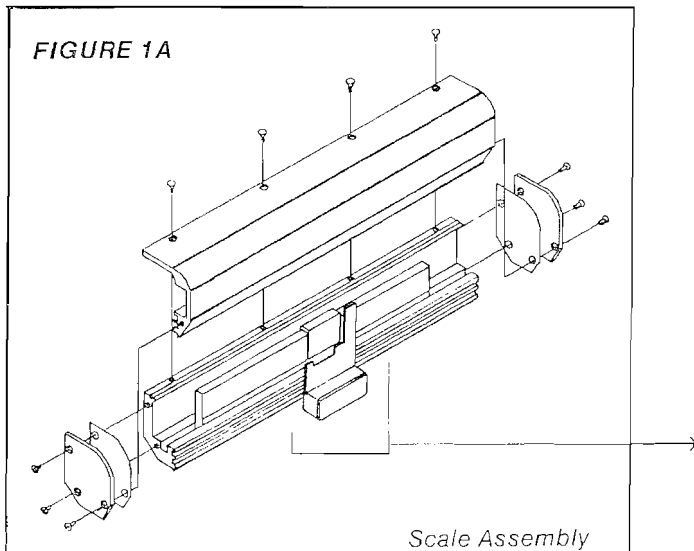
The spar, glass scale, and encoder assembly have been factory aligned and shipped as a complete unit. Two temporary #4-40 screws and metal stand-offs, Fig. 1B Index 1 & 2, hold the encoder "fin" in its proper aligned position to the spar.

NOTE

Do not remove the temporary/alignment screws until the assembly is bolted in place and the installation is completed.

B. PRE-INSTALLATION:

1. Installation of spar, glass scale and encoder assembly on most vertical milling machines is relatively easy and straight forward. STANDARD MACHINE SHOP PRACTICES SHOULD BE EXERCISED AT ALL TIMES.
2. Other types of installations may require different mounting hardware, but at all times the installer must maintain the specified spar alignment tolerances to achieve optimal performance and accuracy.

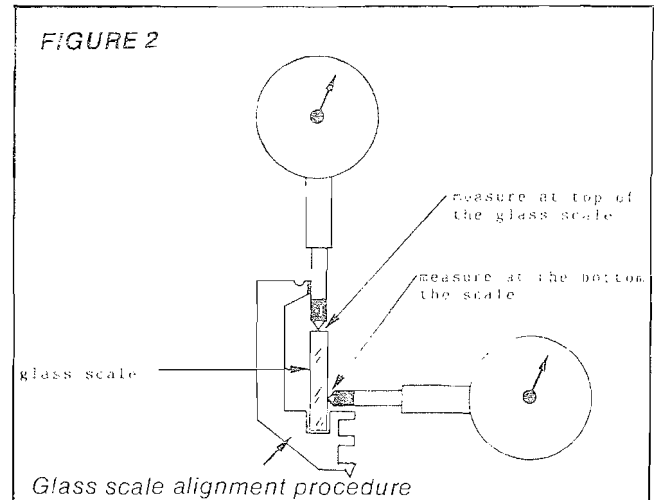


C. SPAR ALIGNMENT TOLERANCES:

1. Using a depth micrometer or dial indicator, indicate the glass scale face surface to parallel the table travel within ± 0.005 inch. Deviations can be corrected by inserting shim stock between the spar and table surface. See Figure 2.
2. Align the glass scale top surface to parallel the table travel within ± 0.005 inch. This alignment can be accurately accomplished by using a depth micrometer or dial indicator. See Figure 2.

NOTE

After installation is completed, it is recommended to recheck all alignment tolerances prior to removing the "fin" screws and stand-offs, inspect for any movement in the encoder assembly. Any encoder movement will require re-alignment.



D. LONGITUDINAL TRAVEL INSTALLATION:

1. Position the table in the middle of its travel (halfway).
2. Remove the mechanical stops from the T-slot in the front of the machine tool table.
3. Remove the table stop bracket on the front of the saddle and mount the reader head bracket, Fig. 4A Index 3, using two bolts, Fig. 4A Index 1, and two washers, Fig. 4A Index 2. The bracket should be mounted as high as possible without rubbing against the table. Bracket may need to be milled or angle changed, for some machines.

NOTE

For Lagun mills and mills that do not have a tapered angle to the front of the saddle, refer to Figure 4B.

4. Reference Figure 1A, remove the end caps, gaskets and cover from the scale.
5. Utilizing the T-slot in the front of the table, mount the scale to that surface as per Figure 3. Be sure that the top of the scale assembly does not sit above the top of the

table and tighten, making sure that the encoder casting box is at the same height as its mounting bracket. See Figure 4C.

NOTE

For some machines the encoder mounting bracket is off-center. To accommodate this, the scale should be adjusted that same amount to the side of the off-set.

NOTE

Be sure that the scale does not effect the table lock. If this occurs a table lock extension is available for your machine. Fig. 4A Index 8 & 9.

6. Align spar as per procedure depicted in above Paragraph C (SCALE ALIGNMENT TOLERANCES).
7. Encoder casting box should now be directly in front of its mounting bracket. Remove the cover from the encoder casting box. See Figure 4A Index 4 & 5.

8. Using a transfer punch, mark the location of the two mounting holes in the casting on to the mounting bracket. Move the table and scale assembly to one side, and drill and tap two #10-32 holes in the mounting bracket.
9. Move the table back so that the encoder casting box is directly in front of the mounting bracket. Align the four set screws, see Figure 4C Index 1, into the encoder casting until the set screws are just snug against the mounting bracket.
10. Insert the two mounting screws and washers, Fig. 4A Index 6 & 7, and tighten (do not over-tighten).

NOTE

Each axis has a green ground wire locking terminal that is placed under one of the mounting screws.

NOTE

Each axis must be grounded.

11. Remove the two temporary #4-40 screws, Fig. 1B Index 2, and traverse the table to either direction so as to expose and remove the two metal stand-offs, Fig. 2 Index 1.
12. Install Display and route cable as per procedure described in Section III of this manual.
13. Replace cover on encoder casting box.
14. Execute performance test as depicted in Section IV.
15. Assemble spar's cover as per Figure 1A.

WARNING! Ensure wires going to encoder do not rub against spar cover or fin.

FIGURE 3

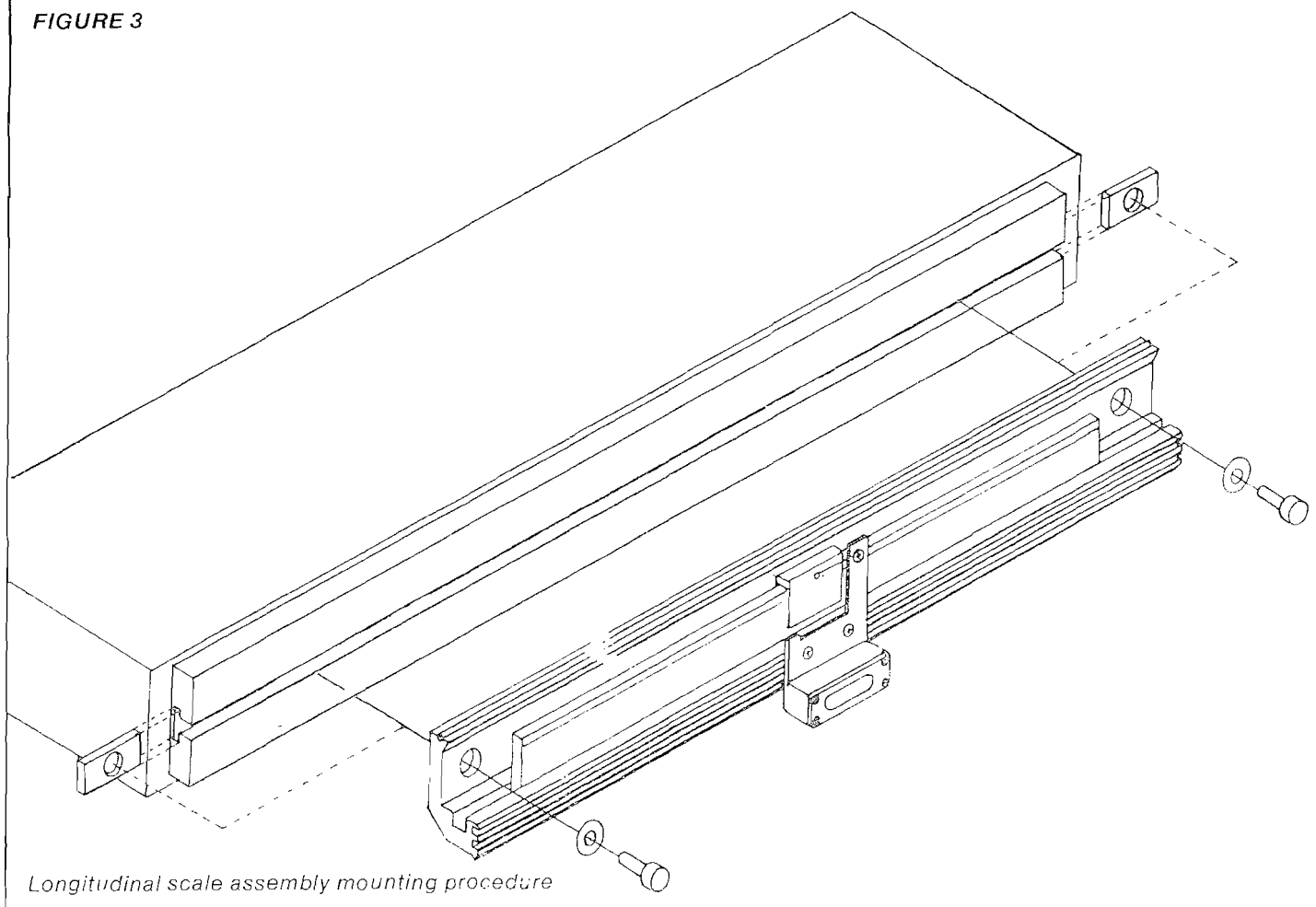
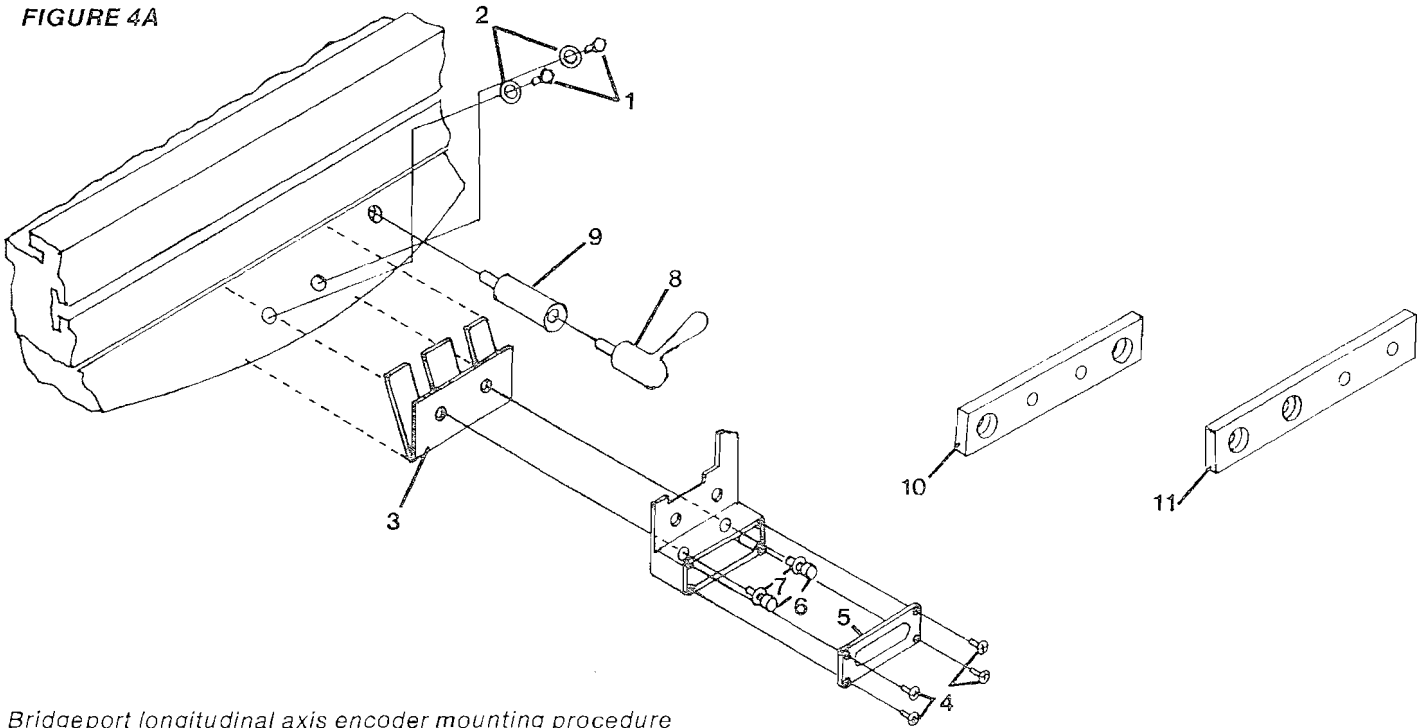
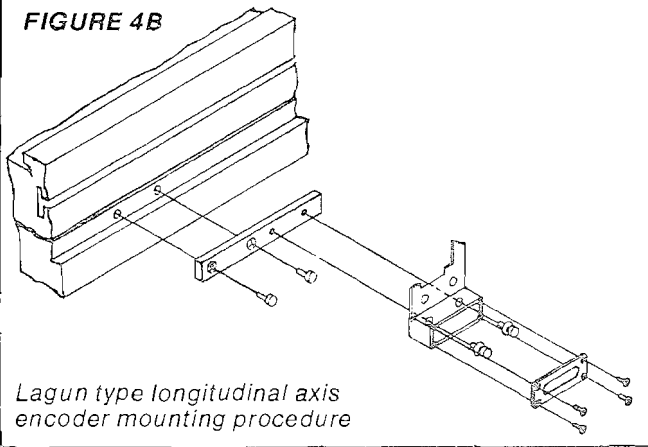


FIGURE 4A



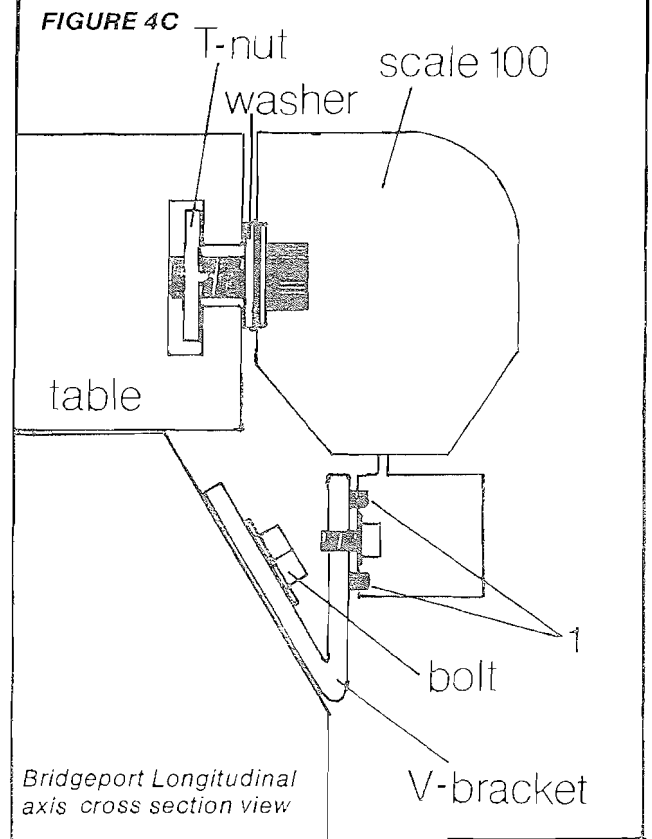
Bridgeport longitudinal axis encoder mounting procedure

FIGURE 4B



Lagun type longitudinal axis encoder mounting procedure

FIGURE 4C



Bridgeport Longitudinal axis cross section view

E. CROSS TRAVEL INSTALLATION

1. Select preferred side of the saddle. Position the cross travel at the center of its travel and lock saddle. Review Figures 5A, 5B and 6. Locate the mounting position. Mount back plate, Figure 5A Index 7 or Figure 6 Index 1, to the knee via two spacers, Figure 6 Index 2, with the screws, Figure 6 Index 3, or washers, Figure 5A Index 1.

NOTE

For some machines the holes are either not drilled, untapped, or are clogged with paint. If this is the case,

drill and/or re-tap the threads to the size required for your machine (see your hardware parts list for bolt size). On some machines there are no holes pre-drilled. If this is the case utilize the universal backing bar, see Figure 5A Index 7.

2. Align back plate as per paragraph C (SPAR ALIGNMENT TOLERANCES). If the universal type back plate is being installed, adjust the four (4) jack screws to align the parallel axis. **WARNING! DO NOT WARP OR TWIST THE BACK PLATE BY JACK SCREW MISALIGNMENT.**

FIGURE 5A

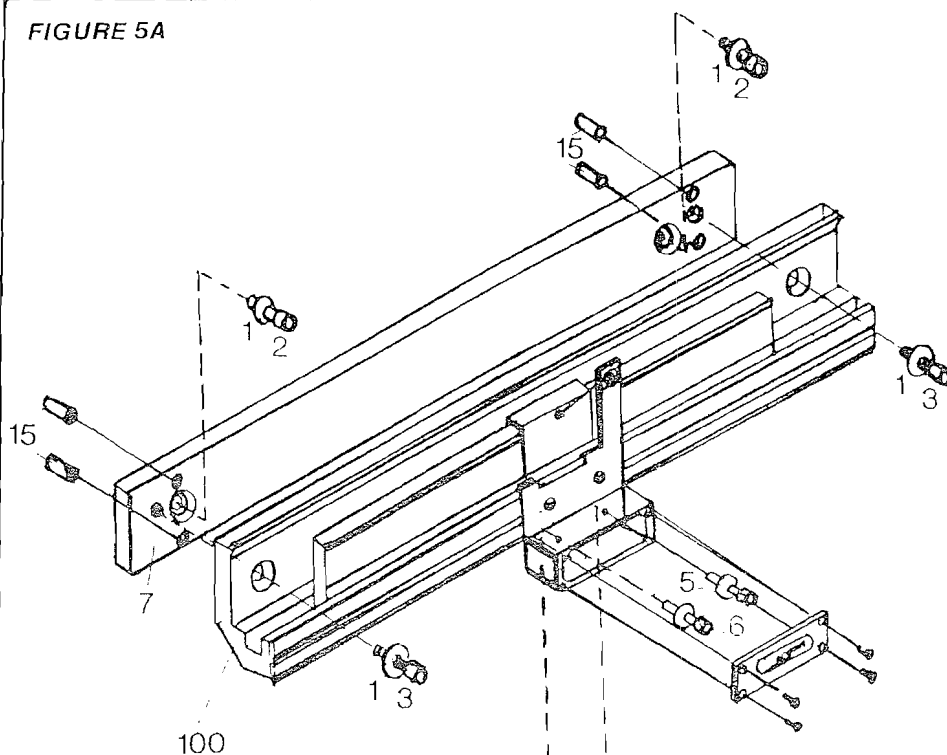


FIGURE 5B

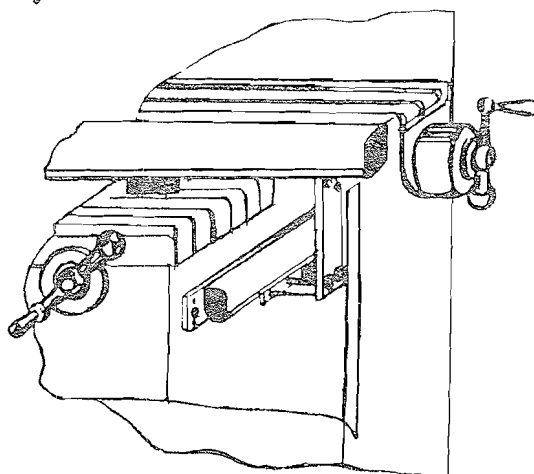


FIGURE 5C

Universal cross-travel mounting procedure

3. Remove the end caps and cover from the scale. See Figure 1A.
4. Mount the spar to the back plate as per Figure 5A or 6.
5. Align (indicate) the scale to the travel (ways) using standard alignment procedures, see Paragraph C.
6. Remove the cover from the encoder casting box, Fig. 8 Index 1, 2 & 3, and temporarily bolt the encoder mounting bracket, Fig. 8 Index 4, to it using two each #10-32 screws and washers.
7. Adjust the table so that the saddle aligns with the encoder bracket, Fig. 8 Index 1, 4 & 7.
8. Transfer the holes located on the encoder bracket onto the saddle. Move the saddle to allow room for drilling. Drill and tap two $\frac{1}{4}$ -20 x 1" deep holes where marked, Fig. 8 Index 7.

NOTE

Bridgeport machines have been factory drilled and tapped.

9. Unbolt the encoder bracket and mount it to the machine, using the two $\frac{1}{4}$ -20 bolts and washers, Fig. 8 Index 4, 5, 6 & 7.
10. Readjust the saddle so that the encoder bracket holes line up with the holes in the encoder casting box. Adjust the four set screws, Fig. 7 Index 1, until the set screws are just snug against the mounting bracket.

11. Insert the two mounting screws and washers, and tighten. DO NOT OVER TIGHTEN. See Figure 8 Index 8 & 9.

NOTE

Each axis has a green ground wire locking terminal that is placed under one of the mounting screws.

NOTE

Each axis must be grounded.

12. Review Figure 5A Index 8, 9 & 10 for an installation concept of Universal cross axis encoder bracket.

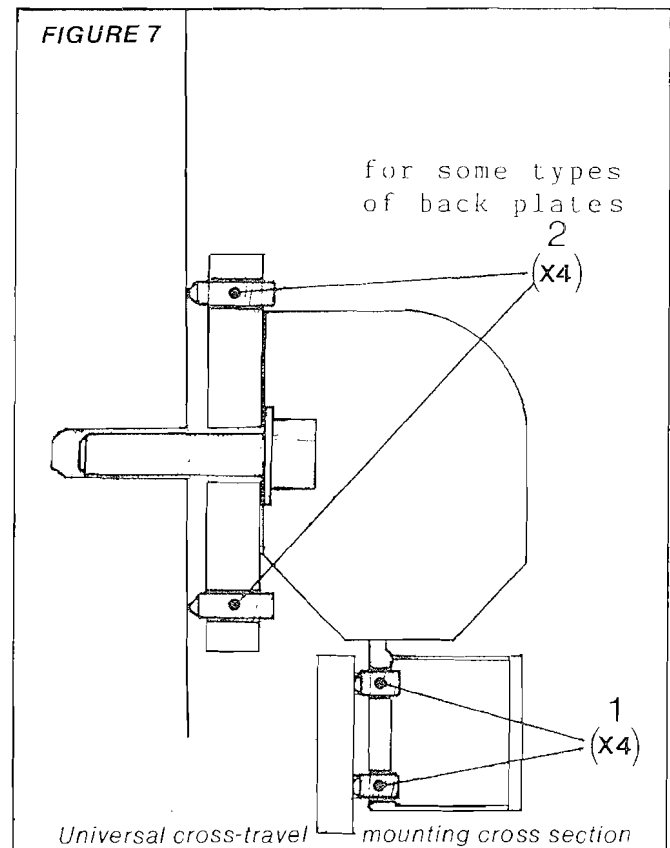
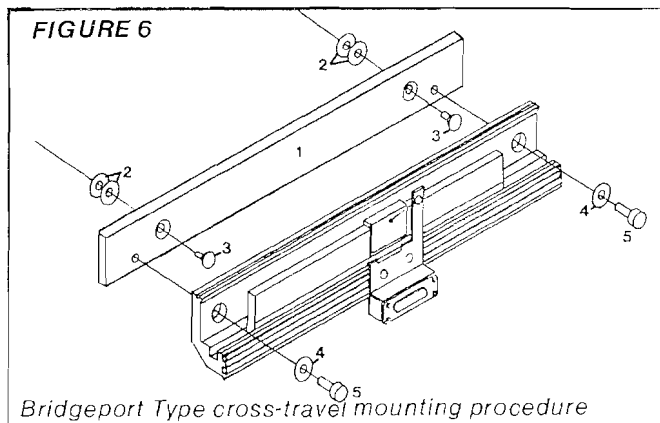
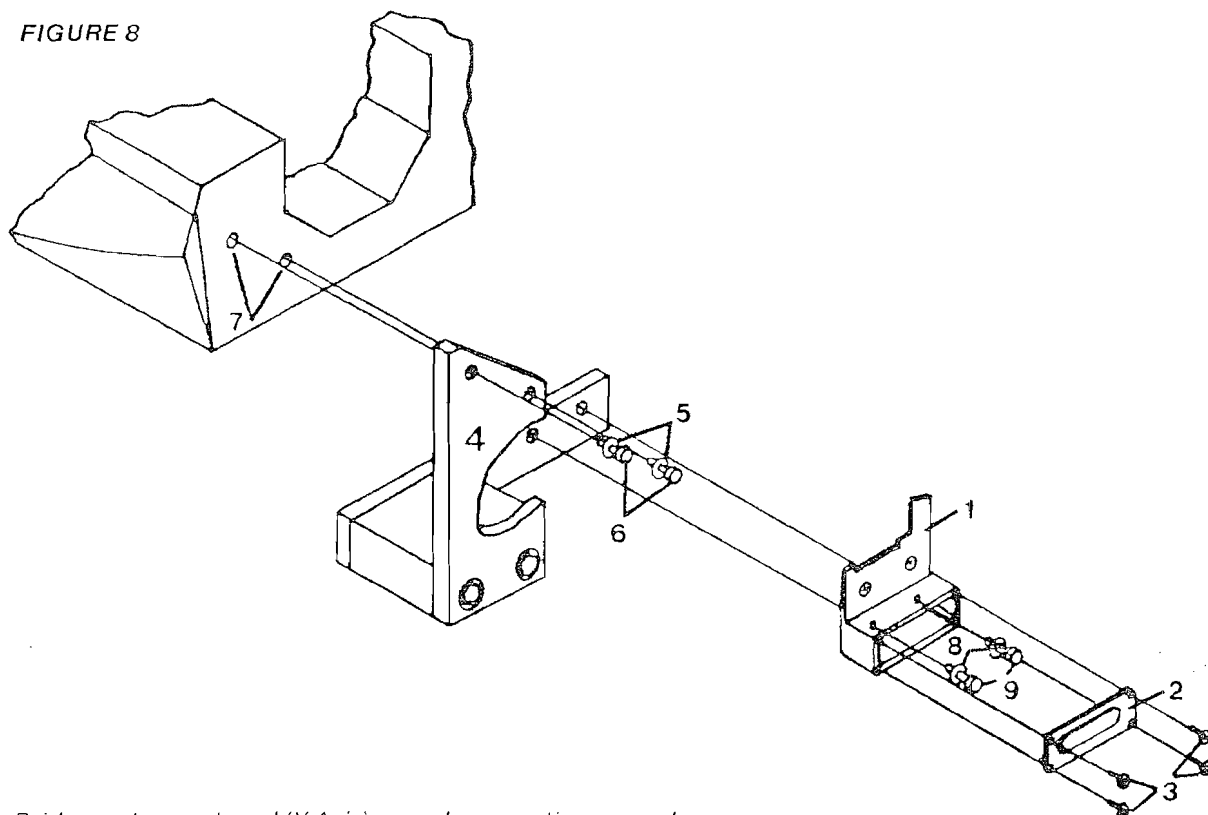


FIGURE 8



Bridgeport cross travel (Y Axis) encoder mounting procedure

II. XT200 SERIES MINISCALE ASSEMBLY INSTALLATION PROCEDURES:

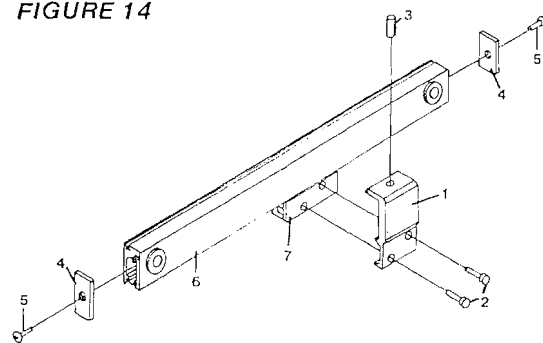
A. INTRODUCTION:

The following instructions are guidelines for installation of SARGON'S XT200 SERIES MINISCALES assembly.

NOTE

This section describes installation procedures for Bridgeport-type knee mills, lathes and grinders, etc. All part numbers are located on each individual hardware kit drawing, located

FIGURE 14



XT200 Miniscale assembly

in each hardware kit. To order replacement or additional parts, use the kit part number and machine manufacturer reference, as some dimensions and parts may vary between manufacturers.

NOTE

Other machine types may require special hardware fabrication. The actual scale installation follows the same concepts. Custom installations may be completed without assistance; however, factory assistance is available if necessary.

The alignment bracket (transportation bracket) assembly, Fig. 1 Index 2 and 3, keeps the encoder in its pre-aligned calibrated state.

NOTE

The bracket should not be removed until installation is completed.

B. PRE-INSTALLATION:

Installation of the miniscale and encoder assembly on most vertical milling machines, lathes and grinders etc., is relatively easy and straight forward. STANDARD MACHINE SHOP PRACTICES SHOULD BE EXERCISED AT ALL TIMES.

Other types of installations may require different mounting hardware, but at all times the installer must maintain the specified scale housing alignment tolerances to achieve optimal performance and accuracies.

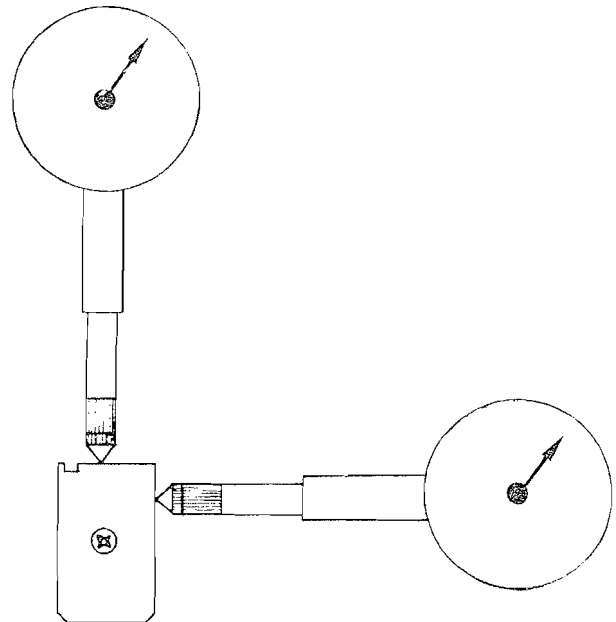
C. SCALE ALIGNMENT TOLERANCES:

1. Using a micrometer or dial indicator, indicate scale housing surface to parallel the table travel within ± 0.005 inch. Deviations can be corrected by inserting shim stock between the scale housing and table surface. See Figure 15 Dial Indicator.
2. Align the scale housing top surface to parallel the table top within ± 0.005 inch. This alignment can be accurately accomplished by using a depth micrometer or dial indicator. See Figure 15 Dial Indicator.

NOTE

After installation is completed, it is recommended to recheck all alignment tolerances prior to removing the alignment bracket. Inspect for any movement in the encoder assembly. Any encoder movement will require re-alignment.

FIGURE 15



XT200 Series housing alignment procedure

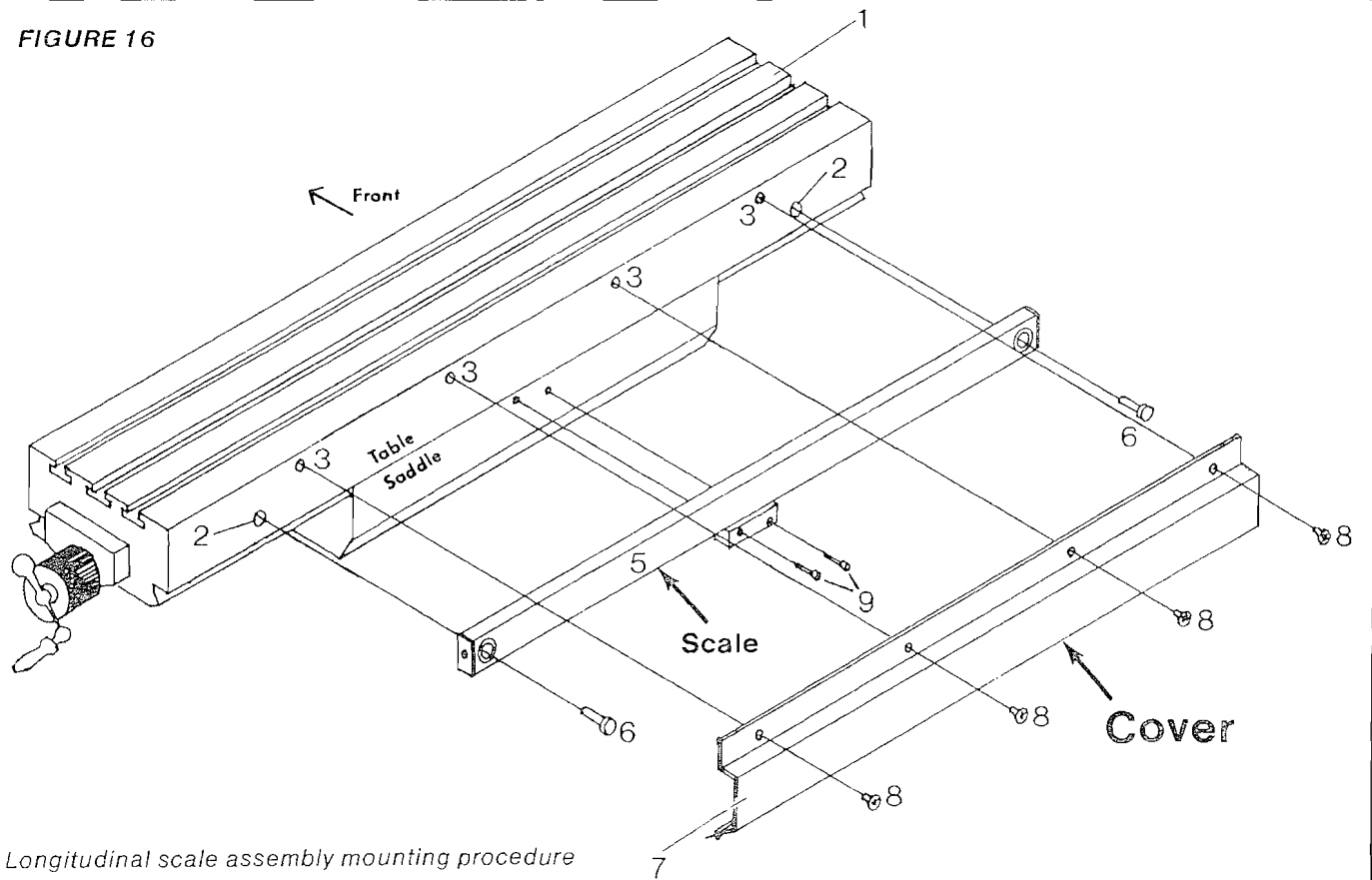
D. LONGITUDINAL TRAVEL INSTALLATION: (X AXIS)

1. Mounting and Alignment of Miniscale Housing. It is recommended to mount the longitudinal scale on the back of the table and mount the encoder to the saddle. Full scale protection can be realized by using Sargon Industries specially designed 515-C Guard cover. See Figure 16.

5. Mounting of Encoder Assembly:

- a. Review gap between encoder assembly and saddle and ensure that it is 0.200 inch or smaller between the encoder and machine surface.
- b. Transfer the two holes, Fig. 16 Index

FIGURE 16



Longitudinal scale assembly mounting procedure

2. Position the longitudinal table at center of its full travel and lock it. Position the scale assembly against the rear of the table so that the bottom longitudinal edge of the scale is flush with the lower edge of the table.
3. Transfer the two 0.3" mounting holes to the table. Drill and tap for $\frac{1}{4}$ -20 $\frac{5}{8}$ " bolts and mount scale assembly as per Figure 16 Index 2, 5 & 6.
4. Using a depth micrometer, or indicator, indicate the scale housing by adjusting the two scale ends horizontal to each other within 0.005 inch or better, See Figure 15.

- c. Adjust the four jack screws, Fig. 17 Index 1, until they just touch the mounting surface.
(DO NOT TIGHTEN THEM.)

NOTE

Misadjustment can force the encoder out of its calibrated position and create erratic scale performance.

- d. Reference Figure 16 Index 9. Mount the encoder with two 4-40 x 3/4 socket head cap screws.

NOTE

Do not over-tighten the encoder mounting screws.

- e. Remove the alignment bracket assembly (Fig 14 Index 1, 2 and 3), and *store the bracket assembly in a safe place* for future use and/or system realignment.

CAUTION

Move the longitudinal table to its two extreme positions while monitoring the encoder travel. Ensure that the table travel is not longer than the encoder travel.

NOTE

If the encoder travel exceeds approximately 1/4 inch from the scale mounting bushing scale and/or encoder will be permanently damaged. If machine travel is greater than encoder travel, table stop must be incorporated to limit table travel.

7. Execute performance test as per Section V.

8. SCALE COVER INSTALLATION:

- a. Position the guard over the scale case ensuring that the guard is resting on the top surface of the scale case. The guard ends should fit between the scales two bushings and flat against the scale case. The encoder cable should be tucked inside the guard.
- b. As per Figure 6 Index 3 and 8, locate, drill and tap for four each 8-32 screws. Mount cover as per Figure 3.

NOTE

Ensure "O" ring gasket is fitted in the guard cover's gasket groove.

E. CROSS TRAVEL INSTALLATION INSTRUCTIONS

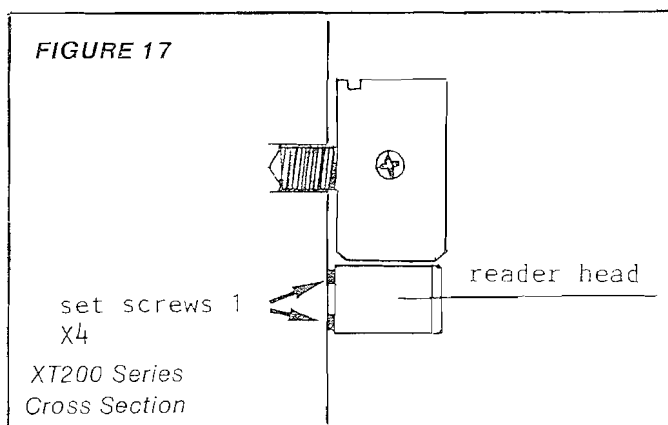
1. Select preferred side of the saddle. Position the cross travel at the center of its travel and lock saddle. Review Figure 18 or 19. Locate the mounting position. Mount scale back plate, Fig. 18 or 19 Index 11.

NOTE

The style of the mounting brackets are determined by type of machine and/or hardware kit.

NOTE

On some machines the holes are either not drilled, untapped, or are clogged with paint. If this is the case drill and/or re-tap the threads to the size required by your machine (see your hardware parts list for bolt size). On some machines there are no holes pre-drilled. If this is the case utilize the universal backing bar, see Figure 19A Index 11.



6. Install display and route cable as per procedures described in Section III of this manual.

2. Align the backplate to the cross travel (saddle) via standard alignment procedures, see Figure 15 Para. C (Scale Alignment Procedures). If the Universal type backplate is being installed, adjust the four (4) jack screws to align the parallel axis.

WARNING

Do not warp or twist the backplate by jack screw misalignment.

3. Mount the scale assembly to the backplate as per Figure 18 or 19.
4. Align (indicate) the scale housing to the travel (ways) using standard alignment procedures, see Para. C (Scale Alignment Procedure).
5. Reference Figure 18 Index 3 & 7, temporarily bolt the encoder to Y axis encoder bracket.
6. Adjust the table so that the saddle is in the center of the Y axis encoder bracket.
7. Transfer the holes in the encoder bracket onto the saddle. Readjust the axis to allow room for drilling. Drill and tap two $\frac{1}{4}$ -20 x 1 inch deep holes where marked, Fig. 17 & 18.

NOTE

Bridgeport machines are pre-drilled.

8. Unbolt the encoder bracket from the encoder and the encoder bracket to the machine, using the two each $\frac{1}{4}$ -20 bolts and washers, see Figure 18 Index 2 and 6.
9. Readjust the saddle so that the encoder bracket holes line up with the two #4-40 screw holes in the encoder casting box. See Figure 18 Index 7.
10. Adjust the four (4) jack screws, Fig. 17 Index 1 until they just touch the saddle surface (DO NOT TIGHTEN THEM).

NOTE

Misadjustment can force the encoder out of its calibrated position and create erratic scale performance.

11. Mount the encoder with two #4-40 x $\frac{3}{4}$ inch socket head cap screws.

NOTE

Do not over-tighten the encoder mounting screws. See Figure 18 Index 7.

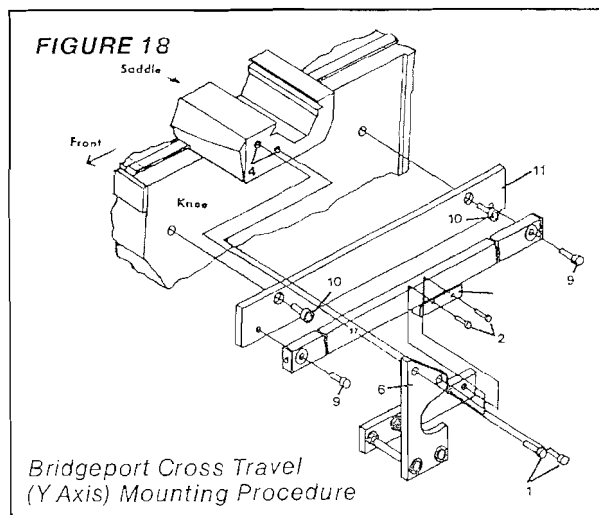
12. Remove the alignment bracket assembly (Figure 14 Index 1, 2 and 3), and store the bracket assembly in a safe place for future use and/or system realignment.

CAUTION

Move the Cross-travel table to its two extreme positions while monitoring the encoder travel. Ensure that the table travel is *not* longer than the encoder travel.

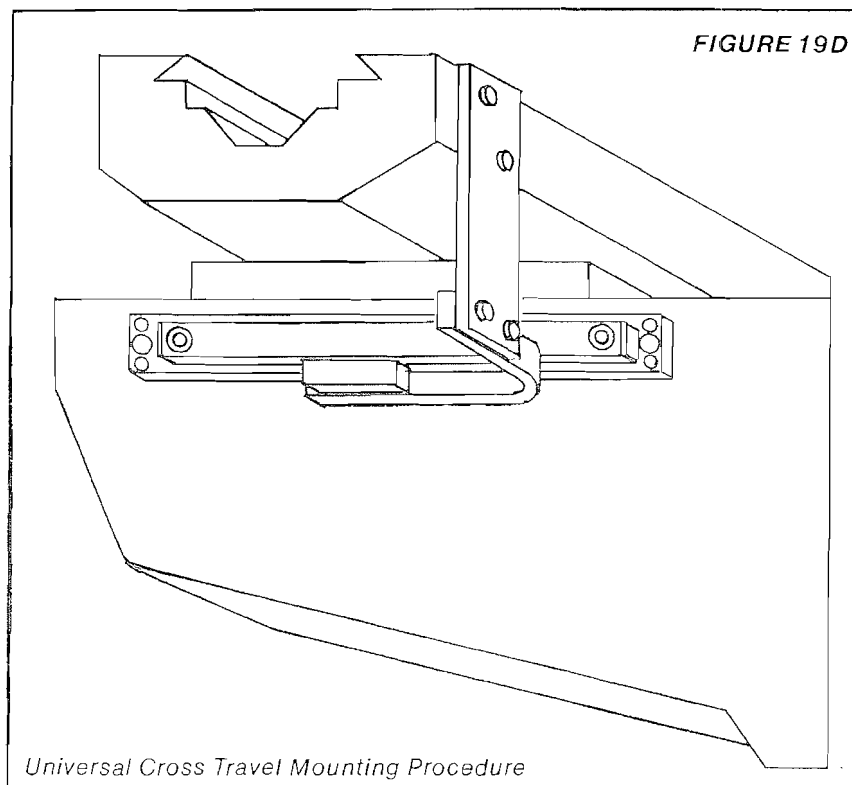
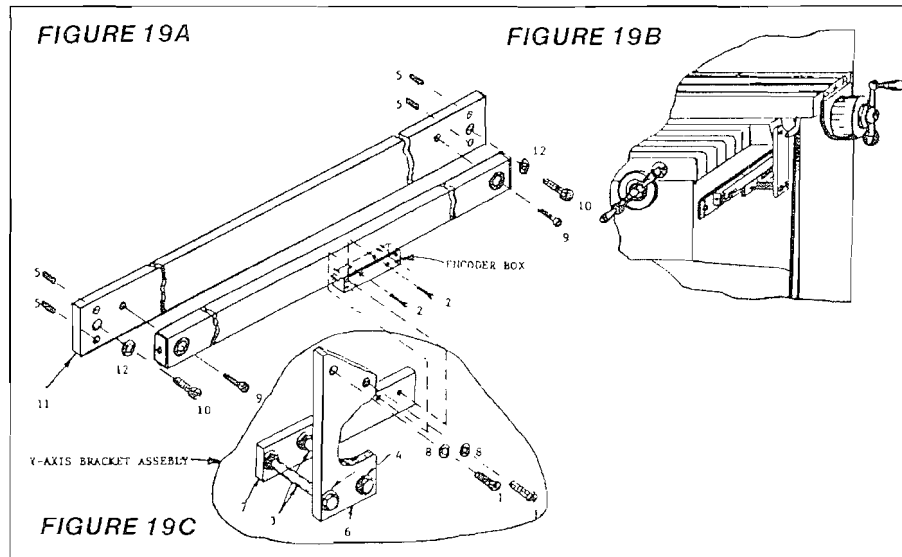
NOTE

If the encoder travel exceeds approximately $\frac{1}{4}$ inch from the scale block bushing, the scale and/or reader head will be permanently damaged. If machine travel is greater than encoder travel, table stop *must* be incorporated to limit table travel.



13. ENCODER CABLE ROUTING:
See SECTION III PARA. B.

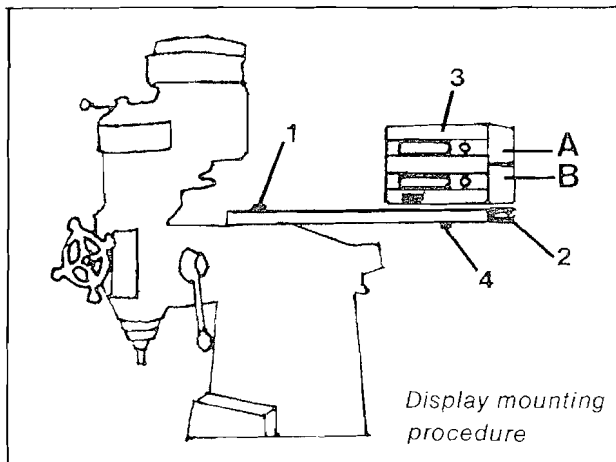
14. Install connector as described in the display section of this manual. Turn on display and perform performance test as prescribed in Section IV Para. A.



III. DISPLAY INSTALLATION AND CABLE ROUTING

A. DISPLAY INSTALLATION:

1. Figure 20 depicts a typical Sargon display installation. The first step is to remove the large eye bolt located on top of the milling machine column, Fig. 20 Index 1, and mount the arm (Index 2), as per Fig. 20. The next step is to bolt the display to the display mounting arm with a 5/16-18 bolt found in the Hardware Kit. See Figure 20 Index 4.
2. The display can be mounted to the bottom of the mounting arm by removing the screws from the top sides of the display case extrusion and then removing the top and bottom half of the case extrusion. Mount the bottom case half on the top side of display. Mount the top half of the case extrusion to the bottom half of the display. After completion, the top half should now have a mounting hole in its center which you use to bolt to the arm.



NOTE

Cable can be fixed to exit either right or left of the encoder box. Ensure sufficient cable loops to allow the table to move to both left and right extremes without exerting tension on the cable. The cable slack should not lie on the floor, or in a situation where it could get pinched, cut, or contaminated by toxic chemicals. All damaged cables MUST be replaced.

2. Each cable connector is terminated into its appropriate mating connector located on the back of the display. Example: X axis scale cable assembly connector will mate with the connector called "X-IN" located on back of the display.

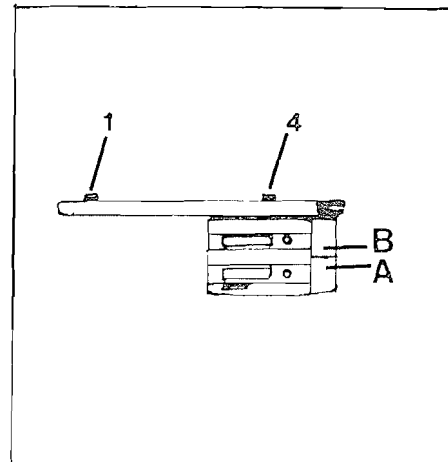


FIGURE 20

B. ENCODER ROUTING:

1. Route the cable from the encoder assembly to the display.

IV. PERFORMANCE TEST

A. OPERATIONAL TEST:

1. Plug in the display power cord to the A.C. Power and turn on the Display power. The Display ON/OFF power switch is located on the upper right hand side of the display back panel.

-
2. ZERO the display by pushing the ZERO button. The display should now read "ZERO".
 3. Adjust the machine tool lead screw dial clockwise to read "ZERO".
 4. With both machines and display on a ZERO reference, crank the table and note if the display is counting. If not consult Section XI (Trouble Shooting Chart Section) for guidance.
 5. Measure a given travel and compare the lead screw dial to the display. They should be relatively close. If not consult the trouble shooting Section.
 6. Tighten the knee and table lock so the table and knee cannot move.
 7. Turn the machine tool power on and off several times. The display should NOT add any new numbers to its count. If it does, check the machine and display grounding system.
 8. Check and/or adjust the machine tools ways, gibs, and lead screw for good condition.
 9. Ensure that a #20 ground wire is connected from the "GND" terminal located on the Display back panel to the "MAINS" earth, ground, such as the conduit for "A.C." building power.
 10. Proceed to the REPEATABILITY and ACCURACY Test below:

B. REPEATABILITY:

1. Repeatability is verified by this test; Machine tool and Digital Readout performance should be periodically checked by this procedure:
2. Mount a dial indicator on the machine tool table in such a manner that the indicator probe tip touches the scale assembly's black end plate when the table is at one of its positions limits.
3. Set dial indicator and the Digital Readout display to zero.

4. Move the machine tool table to its other extreme then bring the table back just past the indicator zero position. Forward the table to read zero on the Dial Indicator. Both the Dial Indicator and DRO display should now read zero plus or minus one count.
5. Perform step 4 at least three (3) times to ensure good repeatability.
6. If repeatability is not realized as per above, consult the trouble shooting Section on repeatability for guidance.

C. ACCURACY:

1. Accuracy test procedures will only verify the machine tool, and DRO installation accuracy. The Sargon glass scale accuracies are at least one thousand times more accurate than most machine tools. Sargon glass scales are traceable to the National Bureau of Standards (N.B.S.).
2. To check accuracy, place reference standard such as certified gage block and/or indicator on the working surface of the table. Simultaneously compare the DRO and reference standard accuracies to each other. Repeat the measurements at least three times. If there is a major discrepancy between the two measurements, recheck the scale installation. Generally speaking, accuracy deviation is contributed to the following:
 - a. Machine tool working area distance from scale. (Abby error)
 - b. Adjustment of machine tool "ways" and "gibs."
 - c. Machine tool basic accuracy.
 - d. Scale encoder installation.
 - e. Scale assembly mechanical alignment.
3. For a better understanding of accuracy review Section X (Machine Tool Error) of this manual.

V. EQUIPMENT INSTALLATION VARIATION

A. GENERAL:

1. The enclosed mounting procedures for both 100 Series and XT200 Series can be adopted to other types of machine tools. It is important that the installer uses good machine shop practices and follows the general concepts of all procedures depicted in this manual.
2. The installer should be prepared to modify and/or manufacture various hardware assemblies. Typical mounting lay-outs are portrayed below:

B. LATHE:

1. See Figure 21 for typical lathe mounting assembly.

C. GRINDER:

1. See Figure 22 for typical grinder mounting assembly.

D. QUILL:

1. See Figure 23 for typical vertical Milling machine quill mounting assembly.

E. KNEE:

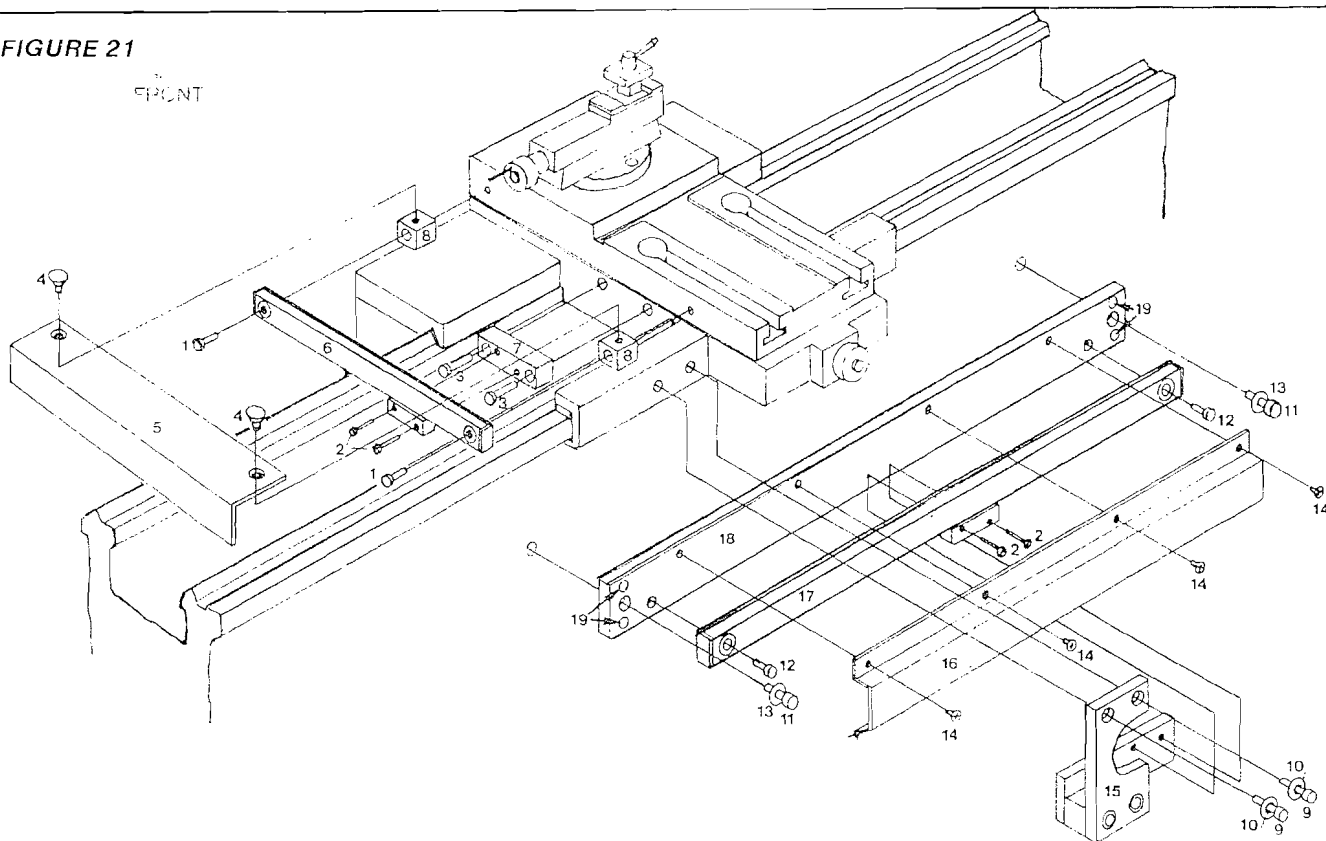
1. See Figure 24 for typical vertical/horizontal milling machine knee mounting assembly.

F. CUSTOM FABRICATION:

1. The installer can fabricate the required hardware assemblies by understanding this manual.

FIGURE 21

FRONT



LD•080884•HWUL

Typical lathe installation

Typical grinder installation

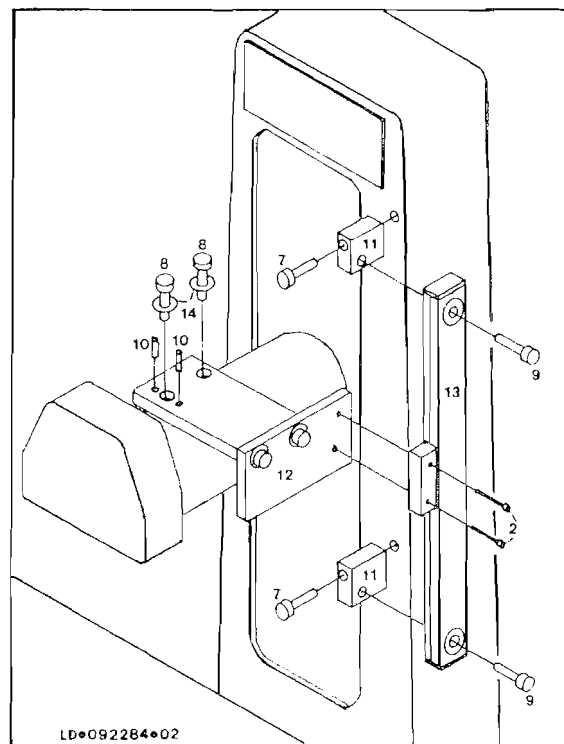
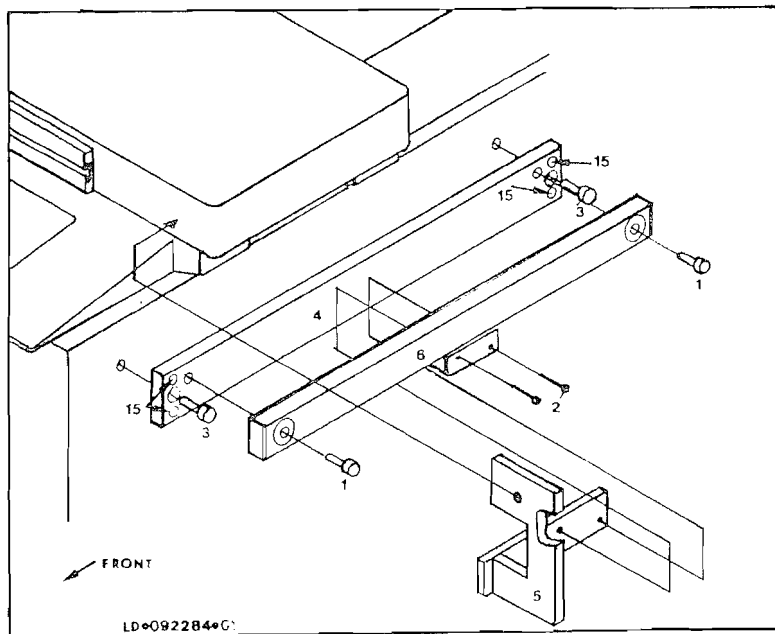


FIGURE 22

Typical milling machine quill installation

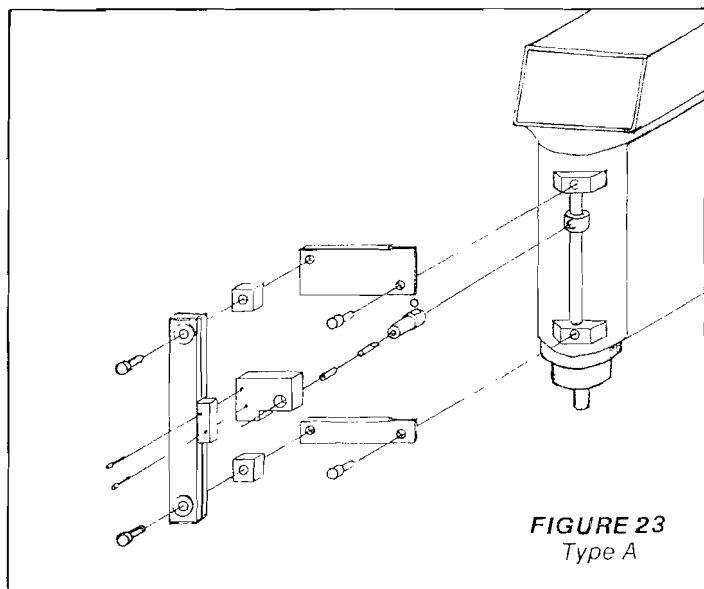


FIGURE 23
Type A

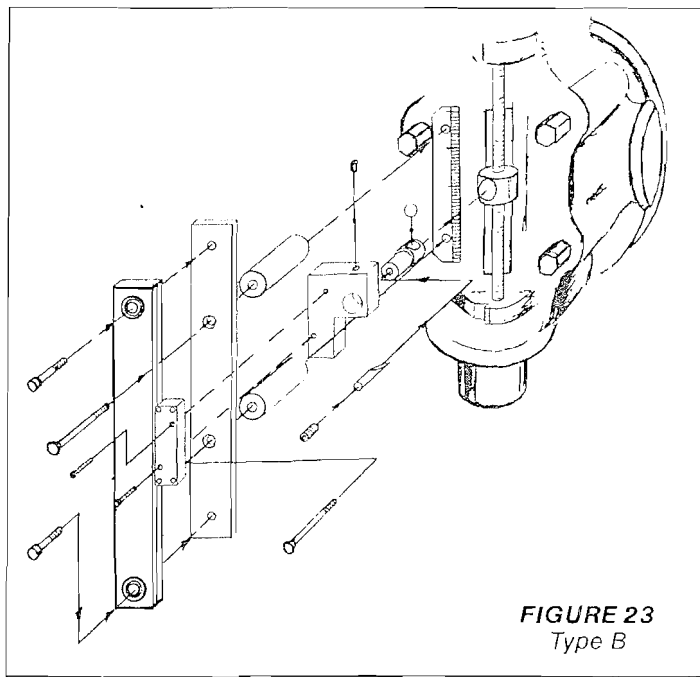
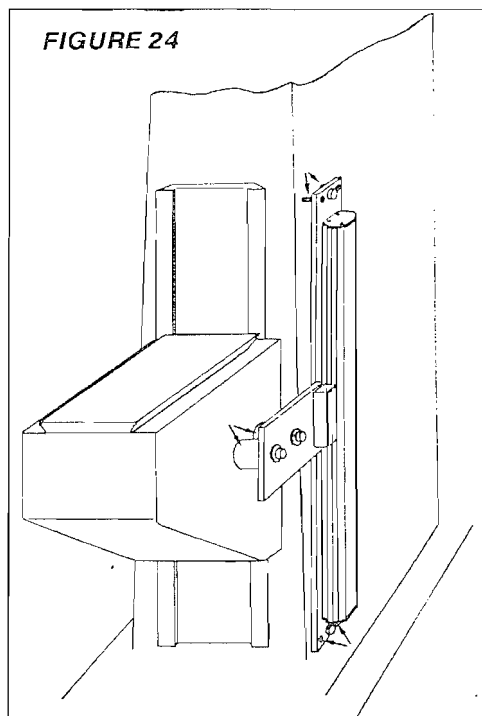


FIGURE 23
Type B

*Typical milling machine
knee installation*



VI. PREVENTATIVE MAINTENANCE

A. CLEANING:

1. DISPLAY:

Dirt on components acts as an insulating blanket and prevents efficient heat dissipation. It also provides an electrical conduction path that can result in instrument failure. The recommended way to clean the interior is to blow off the accumulated dust with dry, low pressure air (approximately nine pounds per square inch). Remove any dirt that remains with a soft brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning narrow spaces, or for cleaning circuit boards. Then blow-dry the dampened area.

- a. Exterior areas may be cleaned with a soft cotton cloth, small paint brush, or soft tissue paper. The paint brush is particularly useful for dislodging dirt on, and around, the front-panel controls. Dirt that remains can be removed with a soft cloth or brush dampened in a mild detergent and water solution or isopropyl alcohol. NEVER USE ABRASIVE OR SOLVENTS.

CAUTION:

- b. The counter display LED filter may easily be scratched when using the above cleaning procedures with dry lense tissue.

Recommended method is:

Gently wash the filter with a soft clean damp cotton cloth and clean water, blow dry with low-pressure dry air. Greasy residues or dirt may be removed with a solution of warm water and a neutral pH liquid detergent, rub gently with a soft cotton cloth.

- c. After cleaning, a visual inspection should be performed to find such defects as broken connectors, heat damaged and/or loose electronic parts, and loose/broken wires. Overheating parts usually indicates other problems or potential trouble in the electronics; therefore, it is recommended to contact the local service center, or the factory.

2. SCALE:

- a. There is no preventive maintenance required for the electronic and optical circuits within the scale encoder. In every one to three years, dust, dirt, cutting fluid, and loose chipping could present a problem. Cleaning procedures are the same as section 1a. above.
- b. 100 Series glass scales and reticle should be cleaned with isopropyl alcohol and dried with a clean cloth or paper towel. Special care should be taken to follow the disassembly and assembly procedures as depicted in the scale installation section. Make sure the scale assembly is secured tightly and aligned properly.
- c. Cleaning procedure for the XT200 Series miniscale is as follows:
 1. Position table so encoder is at one extreme location on the scale housing.
 2. Using *no more* than 20 PSI of air, gently insert the air nozzle through the rubber flaps entrance of the scale housing and blow air *away* from the encoder towards other end of the scale.
 3. Apply the air pressure in such a manner that dirt and particles will migrate to the other end of the glass scale and fall out.
 4. Move the encoder to the opposite end of the scale and apply air pressure as per above instructions.
 5. Using a spray dispenser spray and saturate the glass scale with alcohol.

NOTE

Never blow air or alcohol toward the encoder.

6. Using a "Q" tip or equivalent, gently rub and clean the glass scale.

VII. TROUBLE SHOOTING AND SERVICING

A. GENERAL:

1. The following information is provided to facilitate system trouble shooting procedures and aid the user in communicating problems to the local service center or factory. It is not necessary to understand the circuit operation to find the sub-assembly that is at fault. The factory has individually set up and tested the overall performance before each system is packaged and shipped. In general the system will serve the user without any operating difficulty, and operate to full satisfaction when the system is properly installed and cared for.
2. In the event of an operating difficulty or problem refer to the below appropriate trouble-shooting information guide and see if the problem can be corrected; if not, contact the local Dealer/Service Center, or factory for advice. Depending on the nature of the problem, it may be necessary to ship one of the sub-assemblies or units back to the Dealer or factory. The Counter mother board or power supply replacement is easy when instructions are followed.

NOTE

Do not ship any package to the dealer or factory without prior notification and approval. In such a case, package the components and furnish information as follows:

- a. If shipping scales, make sure to lock the encoder assembly to the spar as per instructions.
- b. Install the component in a sturdy box that is well packaged. If possible use the original box received from factory.
- c. Prepare and enclose in the box a detailed report describing the problem in full. Address the report to your contact who authorized the shipment.
- d. Have the freight prepaid, and the shipment insured.

B. SYSTEM TROUBLE SHOOTING PROCEDURE:

1. **FAULT:** One axis is malfunctioning or seems erratic:

Procedure: Note the malfunctioning reading and switch the "X" and "Y" encoder cables on the back panel of the display. Operate the machine as before, and observe the axis suspected of malfunction. If the fault still appears on the same axis of the display as before the display is at fault. If the malfunction has moved to the other axis, the fault is in the scale assembly. To verify the finding, return the cables to their original connection and repeat the above steps carefully, noting all display readings.

2. **FAULT:** System does not work and the display LED's do not light up:

Procedure: Check the display power cable to make sure that it is plugged in to "Mains Outlet". Ensure power is at the "Mains" outlet socket by plugging in another electrical device, and observe operation. Check display's power fuse located in the back panel of the display. If the fuse has "burned" replace with a 3 AG fuse of proper value. If the fuse burns again or display still does not light up disconnect the scale cables from the display and try again with a new fuse. If the display LED's light up, connect one scale cable at a time until the display LED's light goes out. When an individual scale has been identified to be the fault proceed to Para C. If the display continues to blow fuses when the scale cable is disconnected, the fault is the display.

C. LINEAR SCALE TROUBLE SHOOTING:

1. **100 SERIES TROUBLE SHOOTING PROCEDURES.**

- a. **Fault:** Scales operation is erratic and numbers are jumping.

Possible remedies:

1. Check scale for cleanliness.
2. Check encoder "loading" spring for proper tension.
3. Check the red, black, blue, and green wires that are connected to the encoder for good contact. They should not be rubbing against the spar cover.

4. Check encoder box for tightness and make sure it is not cocked or rubbing against the spar. Ensure the four (4) jack screws in the encoder box are properly adjusted.

5. Ensure connector that mates with the display connector is secure.

6. If the above possible remedies do not resolve your problem contact your local service center or the factory for guidance.

- b. **FAULT:** Scale does not operate.

Possible remedies:

1. Check para C 1a, 2, 3, 4 and 5 above.
2. Replace encoder I.C. chips.
3. Replace encoder reader head.

NOTE

Reader head replacement is simple, see section IX for guidance. Most Sargon dealers and sales representatives have spare encoder reader heads. Approximate time required to change a reader head is five (5) minutes. No special tools or electronic equipment is required.

2. **XT200 SERIES MINISCALE TROUBLE SHOOTING PROCEDURES:**

- a. Scale operation is erratic and numbers are jumping.

Possible remedies:

1. Check scale for cleanliness.
 2. Check the encoder box for tightness and make sure it is not cocked or rubbing against the scale housing.
 3. Check the encoder box for parallelism to the scale housing.
 4. Check the encoder box four (4) alignment jack screws for correct adjustment.
 5. Check the encoder cable assembly for proper routing, and make sure cable is not pulling or dragging the encoder box.
-

6. Check scale assembly connector for proper mating and that it is secured to the display rear panel mating connector.
- b. Scale assembly does not operate.
 1. Replace I.C. chip inside the scale connector housing.
 2. Replace encoder/cable assembly.

CAUTION

Reader head replacement requires some experience and is enhanced by a Sargon Jig P/N J-200.

VIII. DISASSEMBLY AND ASSEMBLY OF DISPLAY

A. GENERAL

The display is disassembled and assembled in the below steps:

B. DISASSEMBLY OF DISPLAY CABINET:

1. Remove the top black #8 screws on each side of the cabinet.
2. Firmly holding the bottom half of the cabinet with one hand, pull the top half of the cabinet with the other until it is free from the display.

C. DISASSEMBLY OF MOTHER BOARD:

1. Remove Mother Board and front panel clear from the bottom half of the cabinet. Be careful not to apply stress on the cable and connector that interface the Mother Board to the Power Supply board.
2. Disconnect the plug attaching the two boards together.
3. Remove the flat ribbon cable connector from rear connector assembly.
4. Remove the red button cap and nuts from the front panel ZERO momentary switches.

NOTE

This step does not apply to Displays automatic preset/reset option or BCD IN or OUT.

D. DISASSEMBLY OF POWER SUPPLY:

1. Disconnect 10 VDC Red/Black power plug.
2. Remove Power Supply and back panel from the cabinet.

E. ASSEMBLY OF MOTHER BOARD:

Perform Para C in reverse.

F. ASSEMBLY OF POWER SUPPLY:

Perform Para D in reverse.

G. ASSEMBLY OF CABINET:

Perform Para B in reverse.

IX. 100 SERIES ENCODER ASSEMBLY REPLACEMENT

A. INSTRUCTION FOR REPLACEMENT OF P/N RP 6 OR SIMILAR ENCODERS:

1. Remove the scale assembly end plates and spar cover as per Section 1 Fig 1A of Instruction Manual.
2. Disconnect the red, black, blue and green wires connected to the encoder by gold "quick" disconnect pins.
3. Gently lift the spring that connects the encoder to the encoder box with needle nose pliers and slide the encoder off the left end of the glass scale.

CAUTION

Place a piece of paper between the glass and spring, so as not to scratch the glass.

NOTE

In some cases, the spar mounting bolt may be in the way of the encoder. If so, remove bolt and realign the spar as per Section 1 C of this manual after encoder replacement has been completed.

4. Slide the new encoder on to the scale and reconnect spring and wires as per below Fig 25.

CAUTION

Do not allow the glass scale to rub, or touch the four (4) each encoder infrared LED's located on the bottom printed circuit board that sandwiches the glass scale.

NOTE

Prior to installing the new encoder, inspect the encoder spring to ensure it is "loaded" properly. The spring tension should be loaded in such a manner that the eye is firmly resting on the glass scale center open line. The spring eye *should not* be "cocked." SPRING LOADING ADJUSTMENT IS AS FOLLOWS: Using a pair of "duck-billed" pliers, firmly grasp the spring close to its termination, and bend it down to the point where the glass is

cemented in the spar. Repeat the above step until the spring memory positions the spring eye as per above.

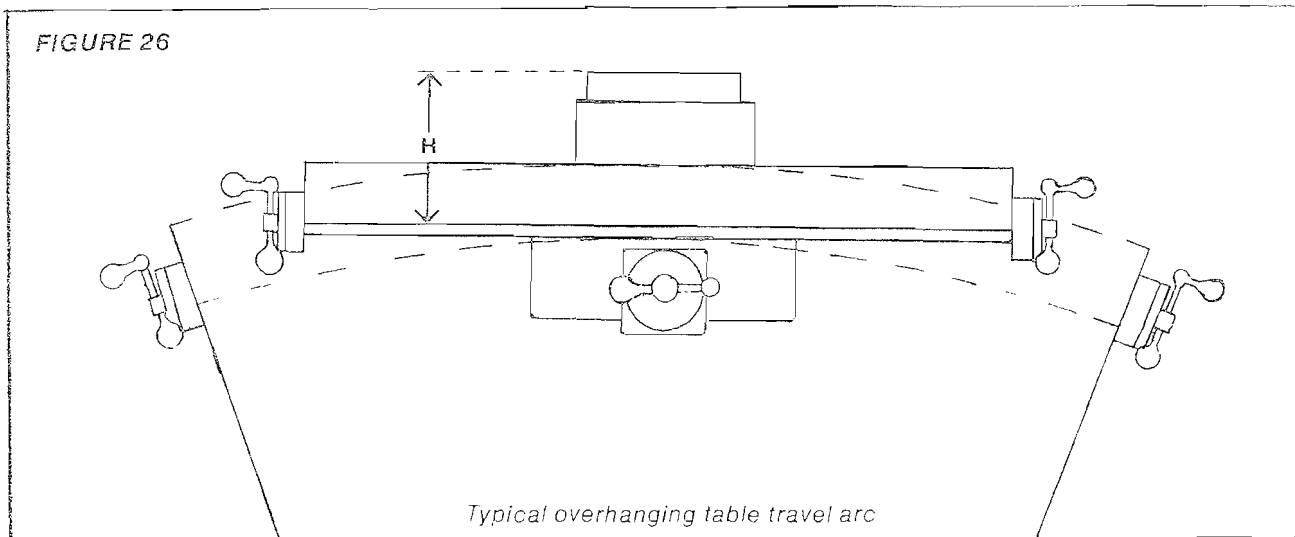
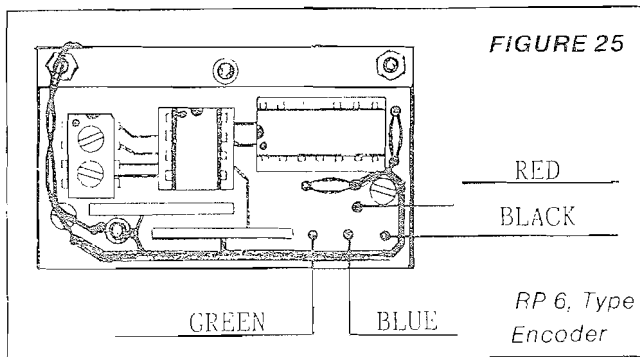
X. MACHINE TOOL ERROR

- A. For obvious reasons, scales cannot be mounted right where machine work is going to take place. A standard vertical milling machine using linear scales would not have any error if it's table movement followed a perfect straight line. Since this is not always the case, and often table movement deviates somewhat, there will be transfer error. Transfer error refers to the difference between the displacement of the scales reader head and the machine tool cutter.

Some sources of error include the following:

1. Crooked ways.
2. Worn out and loose ways and gibs.
3. Bending and deflection of tables caused by gravity, etc.
4. Deflection and distortion caused by cutting and driving forces.
5. Geometric distortion of machine due to temperature.

An example of non-linear movement is overhang in knee-type mills. This is shown in Fig. 26. Because of the pull of gravity on the table as it moves to the sides, its movement is likely to conform to a circular arc around a center far below the machine.



To illustrate this concept further, the error is given by the following equation:

$$E = \theta h$$

where E = error,

θ = pitch angle in radians

h = distance between working plane and the measuring plane.

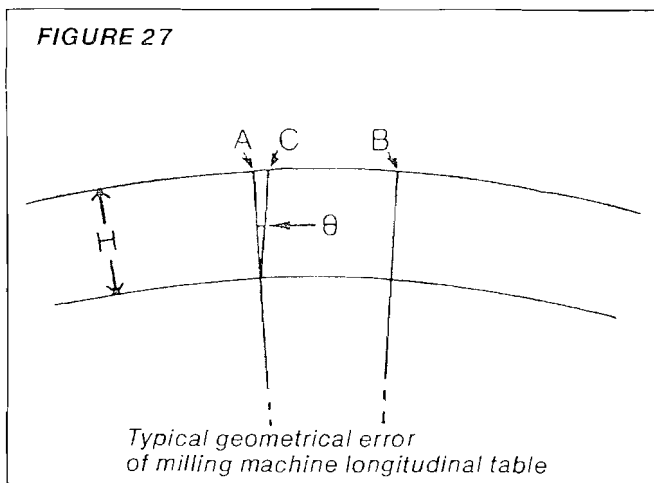
A & B are radii, and C is parallel to B.

Here, AC corresponds to the arc of error:

$$E = AC = AB - DE.$$

Machine tool errors are not limited to old machines. Large table errors can exist in new machines as well. A skilled machinist can identify errors of his machine and can compensate for them by either leading or lagging the table and meet required tolerances.

Table movement will deviate somewhat and there will be some transfer error. Transfer error refers to the difference between the displacement of work place and the displacement of the scale's reader head.



For convenience, the following table shows some results of the error function.

FIGURE 28

| | 1 SEC. | 5 SEC. | 15 SEC. | 30 SEC. | 1 MIN. | 3 MIN. | 5 MIN. |
|-----|--------|--------|---------|---------|--------|--------|--------|
| .5" | .00000 | .00001 | .00004 | .00008 | .00015 | .00044 | .00072 |
| 1" | .00000 | .00002 | .00007 | .00015 | .00029 | .00087 | .00145 |
| 2" | .00001 | .00005 | .00015 | .00029 | .00058 | .00175 | .00291 |
| 4" | .00002 | .00010 | .00029 | .00058 | .00116 | .00349 | .00582 |
| 8" | .00004 | .00020 | .00058 | .00116 | .00233 | .00698 | .01164 |
| 16" | .00008 | .00038 | .00116 | .00233 | .00465 | .01396 | .02327 |

Typical machine tool table transfer error

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XT 200 SERIES DRAWINGS

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DIGITAL READOUT SPECIFICATION

DISPLAY:
7 digits and ± sign per axis using high performance nitrogen-doped, GaAsp on Gap 0.560" LED's that are readable to over 20' at 150° viewing angle.
DISPLAY RESOLUTION:
0.0005" or 0.01 mm.

MAXIMUM DISPLAY RANGE:
INCH: ± 999.9995, METRIC: ± 9999.99 mm.

CIRCUITRY:
All integrated circuitry, including LSI and CMOS logic technology.

RESPONSE SPEED:
50 kHz

SIGNAL INPUTS:
One encoder/instrument interface connector per axis.

POWER INPUT:
115VAC ± 20%, 48-62Hz switchable to 100,230 and 240 VRMS.

OPERATING TEMPERATURE:
0°C (32°F) to 50°C (122°F)

COUNTER ORDERING INFORMATION

| DIGITAL DISPLAY | MODEL NUMBER |
|--|---|
| Single Axis Display | 711A |
| Two Axis Display | 712A |
| Three Axis Display | 713A |
| Hardware Kits 100 Series Regular Scales: | |
| 509-00BP | Bridgeport mounting hardware kit and arm |
| 509-00BPC | Bridgeport Universal mounting hardware kit & arm |
| 509-EX | Excello hardware kit and arm |
| 509-00-K | Knee Z axis mounting hardware kit and arm |
| 509-KDIA | Kondia hardware kit and arm |
| 509-00L | Lagun mounting hardware kit and arm |
| 509-30SMAX | Supermax 30" travel hardware kit and arm |
| 509-34SMAX | Supermax 34" travel hardware kit and arm |
| 509-00-WIX | Wells mounting hardware kit for 747,847,887,Index |
| 509-XX-100 | Universal hardware kit and arm for mills |
| Hardware Kits 200 Series Miniscales: | |
| 515-M-BP | Bridgeport hardware kit and arm |
| 515-M-BPC | Bridgeport hardware kit and arm Universal |
| 515-M-EX | Excello hardware kit and arm |
| 515-M-K | Knee hardware kit |
| 515-M-KDIA | Kondia hardware kit and arm |
| 515-M-L | Lagun hardware kit and arm |
| 515-M-Q | Quill hardware kit |
| 515-M-SMAX | Supermax hardware kit and arm |
| 515-XX-200 | Universal hardware kit and arm for mills |

| OPTIONAL ACCESSORIES | MODEL NUMBER |
|--------------------------|--------------|
| Instrument Mounting Arm | 105-00 |
| Instrument Control Cable | 190-15 |
| 15' Extension | |
| Instrument Control Cable | 190-20 |
| 20' Extension | |
| Shielded Power Cord | 190-PC |

SCALE ASSEMBLY SPECIFICATIONS

ACCURACY:
0.0003" total within 3', Beyond 3', add 0.0001" total per foot.

RESOLUTION:
0.0005", 0.01 mm

REPEATABILITY:
0.0004", 0.01 mm

OUTPUT CHARACTERISTICS:
Two 5 volt quadrature square waves that are TTL compatible.

SCALE ASSEMBLY ORDERING INFORMATION

| SCALE ASSEMBLY LENGTH | | MODEL NUMBER | MODEL NUMBER |
|-----------------------|-----------|----------------|--------------|
| Inches | Metric | Regular Scales | Miniscale |
| 2" | (50 mm) | ..... | XT-250-02 |
| 4" | (100 mm) | ..... | XT-250-04 |
| 5" | (125 mm) | ..... | XT-250-05 |
| 6" | (150 mm) | 100-06-X | XT-250-06 |
| 8" | (200 mm) | 100-08-X | XT-250-08 |
| 10" | (250 mm) | 100-10-X | XT-250-10 |
| 12" | (305 mm) | 100-12-X | XT-250-12 |
| 14" | (355 mm) | ..... | XT-250-14 |
| 16" | (405 mm) | 100-16-X | XT-250-16 |
| 18" | (455 mm) | 100-18-X | XT-250-18 |
| 20" | (505 mm) | 100-20-X | XT-250-20 |
| 24" | (610 mm) | 100-24-X | XT-250-24 |
| 26" | (660 mm) | ..... | XT-250-26 |
| 28" | (700 mm) | 100-28-X | XT-250-28 |
| 30" | (760 mm) | 100-30-X | XT-250-30 |
| 32" | (800 mm) | 100-32-X | XT-250-32 |
| 36" | (915 mm) | 100-36-X | XT-250-36 |
| 40" | (1000 mm) | 100-4-X | XT-250-40 |
| 42" | (1065 mm) | 100-42-X | XT-250-42 |
| 46" | (1165 mm) | ..... | XT-250-46 |
| 48" | (1220 mm) | 100-48-X | XT-250-48 |
| 50" | (1310 mm) | ..... | XT-250-50 |
| 54" | (1370 mm) | ..... | XT-250-54 |
| 60" | (1525 mm) | 100-60-X | ..... |
| 62" | (1550 mm) | 100-62-X | ..... |
| 65" | (1650 mm) | 100-65-X | ..... |
| 70" | (1778 mm) | 100-70-X | ..... |
| 80" | (2000 mm) | 100-80-X | ..... |
| 90" | (2250 mm) | 100-90-X | ..... |
| 96" | (2400 mm) | 100-96-X | ..... |
| 100" | (2500 mm) | 100-100-X | ..... |
| 110" | (2750 mm) | 100-110-X | ..... |
| 120" | (3000 mm) | 100-120-X | |
| 130" | (3250 mm) | 100-130-X | |
| 140" | (3500 mm) | 100-140-X | |
| 150" | (3750 mm) | 100-150-X | |

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